

# ENGINEERING BULLETIN

Ref Document No.	EB17006	Issue No.	1
Subject	COALTRAM® MONEx Compliance Audit to ASNZS60079.25		
Release Date	30 <sup>th</sup> June 2017		

## Purpose

To provide a supplementary response and information to owners, operators and designer with reference to Safety Alert SA17-06 - Flameproof Alternators Supplying Intrinsically Safe Equipment released by the NSW Resources Regulator.

**Applicability** – In service COALTRAM® models – CT08, CT10, CT10LP & CT13

## Information

The purpose of this bulletin is to provide a partial response to the Safety Alert SA17-06.

Recommendations outlined in the associated Safety alert requested that, Mine operators contact the machine manufacturer to confirm that the “Intrinsically Safe Equipment fitted to machine is not being operated or exposed to overvoltage conditions that may exceed the certified safe levels of the intrinsically safe equipment.”

PPK have conducted an internal ASNZS60079.25 review of the installed MONEx configuration in COALTRAM® machines.

The associated MONEx information contained in this bulletin (see attached references as outlined) is to supplement any initial field investigation regarding compliance review with ASNZS60079.25.

Note: that the basis for review utilised an Intrinsically Safe (IS) Entity analysis prior to PPK's ownership of the MONEx equipment. As such, a follow up IS prescriptive drawing is being conducted and will be available in due course substantiating the latest configuration for convenience.

## Recommendations

It is recommended that, Plant Owners and operators of all COALTRAM® machines review the supplied information contained within this bulletin.

Specifically, ensure that the machine configurations are individually assessed with the attached supplied information (given over time some cables and associated components may have been altered with respect to 'as built' new machine).

Where an alternative configuration is substantiated, individual assessment to ASNZS60079.25 is suggested to satisfy recommendations outlined in SA17-06.

## Attached References

- ER17007 - COALTRAM - 60079.25-2011 Audit
- 14.EN\_12010\_Entity balance\_2

## Technical Department

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## ER17007 - AS/NZS 60079.25 2011 COMPLIANCE AUDIT

This assessment is for the compliance of the COALTRAM® MONEx system to AS/NZS60079.25 2011 Intrinsically safe electrical systems. For full I.S. assessment details, refer to the drawing 12010 Rev 2 "MONEX ENGINE MANAGEMENT CT8, CT10, CT13 ENTITY ANALYSIS" sheets 1 to 11.

Clause AS/NZS 60079.25	Description	Complies			Comments
		YES	NO	N/A	
<b>SECTION 4</b>	<b>Descriptive system document</b> A descriptive system document shall be created for all systems. The descriptive system document shall provide an adequate analysis of the safety achieved by the system. The minimum requirements are as follows:	✓			
(a)	block diagram of the system listing all the items of apparatus within the system including simple apparatus and the interconnecting wiring. An example of such a diagram is shown in Figure E.1	✓			
(b)	a statement of the group subdivision (for Groups II and III), the level of protection for each part of the system, the temperature classification, and the ambient temperature rating in accordance with Clauses 5, 6 and 7			✓	The system is not installed in a Group II/II environment
(c)	the requirements and permitted parameters of the interconnecting wiring in accordance with Clause 8	✓			
(d)	details of the earthing and bonding points of the systems in accordance with Clause 11. When surge protection devices are used, an analysis in accordance with Clause 12 shall also be included			✓	The system uses galvanic isolation and does not require earthing or bonding for Ex protection.
(e)	where applicable, the justification of the assessment of apparatus as simple apparatus in accordance with IEC 60079-11 shall be included	✓			
(f)	where the intrinsically safe circuit contains several pieces of intrinsically safe apparatus the analysis of the summation of their parameters shall be available. This shall include all simple apparatus and certified intrinsically safe apparatus	✓			The system uses a star topology and does not contain additive entity parameters.
(g)	a unique identification of the descriptive system document shall be created				Refer to the drawing 12010 Rev 2 "MONEX ENGINE MANAGEMENT CT8, CT10, CT13 ENTITY ANALYSIS"
(h)	the system designer shall sign and date the document	✓			

Clause AS/NZS 60079.25	Description	Complies			Comments
		YES	NO	N/A	
<b>SECTION 5</b>	<b>Grouping and classification</b> Intrinsically safe electrical systems shall be placed in a Group I, Group II or Group III as defined in IEC 60079-0. Groups II and III intrinsically safe electrical systems as a whole or parts thereof shall be given a further subdivision of the Group as appropriate. Apparatus within Groups II and III intrinsically safe electrical system, intended for use in explosive gas or dust atmospheres, shall be given a temperature class or maximum surface temperature in accordance with IEC 60079-0, IEC 60079-11, IEC 61241-0 and IEC 61241-11 as applicable.	✓			The system is designed for a Group I environment only.
<b>SECTION 6</b>	<b>Levels of protection</b>				
6.1	General Each part of an intrinsically safe electrical system intended for use in an explosive atmosphere will have a level of protection of "ia", "ib" or "ic" in accordance with IEC 60079-11. The complete system need not necessarily have a single level of protection.	✓			The system utilizes a combination of Ex i protection levels. Ex "ia" and Ex "ib"
6.2	Level of protection "ia" Where the requirements applicable to electrical apparatus of level of protection "ia" (see IEC 60079-11) are satisfied by an intrinsically safe system or part of a system considered as an entity, then that system or part of a system shall be placed in level of protection "ia".	✓			
6.3	Level of protection "ib" Where the requirements applicable to electrical apparatus of level of protection "ib" (see IEC 60079-11) are satisfied by an intrinsically safe system or part of a system considered as an entity, then that system or part of a system shall be placed in level of protection "ib".	✓			
6.4	Level of protection "ic" Where the requirements applicable to electrical apparatus level of protection "ic" (see IEC 60079-11) are satisfied by an intrinsically safe system or part of a system considered as an entity, then the system or part of a system shall be placed in level of protection "ic".			✓	
<b>SECTION 7</b>	<b>Ambient temperature rating</b> Where part or all the intrinsically safe system is specified as being suitable for operation outside the normal operating temperature range of -20 °C and +40 °C, this shall be specified in the descriptive system document.	✓			Various parts of the system are designed for specific environments where the Tamb ranges from -20 °C through to +120 °C. Each piece of equipment has been assessed, Ex certified and adequately marked for each environment.

Clause AS/NZS 60079.25	Description	Complies			Comments
		YES	NO	N/A	
<b>SECTION 8</b>	<p><b>Interconnecting wiring / cables used in an intrinsically safe electrical system</b></p> <p>The electrical parameters of the interconnecting wiring upon which intrinsic safety depends and the derivation of these parameters shall be specified in the descriptive system document. Alternatively, a specific type of cable shall be specified and the justification for its use included in the documentation. Cables for the interconnecting wiring shall comply with the relevant requirements of Clause 9. Where relevant, the descriptive system document shall also specify the permissible types of multi-core cables as specified in Clause 9, which each particular circuit may utilize. In the particular case where faults between separate circuits have not been taken into account, then a note shall be included on the block diagram of the descriptive system document stating the following: "where the interconnecting cable utilizes part of a multi-core cable containing other intrinsically safe circuits, then the multi-core cable shall be in accordance with the requirements of a multi-core cable type A or B, as specified in Clause 9 of IEC 60079-25". A multi-core cable containing circuits classified as level of protection "ia", "ib" or "ic" shall not contain non-intrinsically safe circuits. "ic" multi-core cables may contain more than one intrinsically safe "ia", "ib" or "ic" circuit subject to the applicable faults specified in Clause 13.</p>	✓			Refer to the drawing 12010 Rev 2 "MONEX ENGINE MANAGEMENT CT8, CT10, CT13 ENTITY ANALYSIS"
<b>SECTION 9</b>	<b>Requirements of cables and multi-core cables</b>				
9.1	<p><b>General</b></p> <p>The diameter of individual conductors or strands of multi-stranded conductors within the hazardous area shall not be less than 0,1 mm. Only insulated cables with insulation capable of withstanding a dielectric test of at least 500 V a.c. or 750 V d.c. shall be used in intrinsically safe circuits.</p>	✓			Refer to the drawing 12010 Rev 2 "MONEX ENGINE MANAGEMENT CT8, CT10, CT13 ENTITY ANALYSIS", sheet 11.
9.2	<p><b>Multi-core cables</b></p> <p>The radial thickness of the insulation of each core shall be appropriate to the conductor diameter and the nature of the insulation with a minimum of 0,2 mm. Multi-core cables shall be capable of withstanding a dielectric test of at least:</p> <p>a) 500 V r.m.s. a.c. or 750 V d.c. applied between any armouring and/or screen(s) joined together and all the cores joined together. b) 1 000 V r.m.s. a.c. or 1 500 V d.c. applied between a bundle comprising one half of the cable cores joined together and a bundle comprising the other half of the cores joined together. This test is not applicable to multi-core cables with conducting screens for individual circuits.</p> <p>The dielectric strength test shall be carried out in accordance with an appropriate cable standard or dielectric strength tests of IEC 60079-11.</p>	✓			Refer to the drawing 12010 Rev 2 "MONEX ENGINE MANAGEMENT CT8, CT10, CT13 ENTITY ANALYSIS", sheet 11.

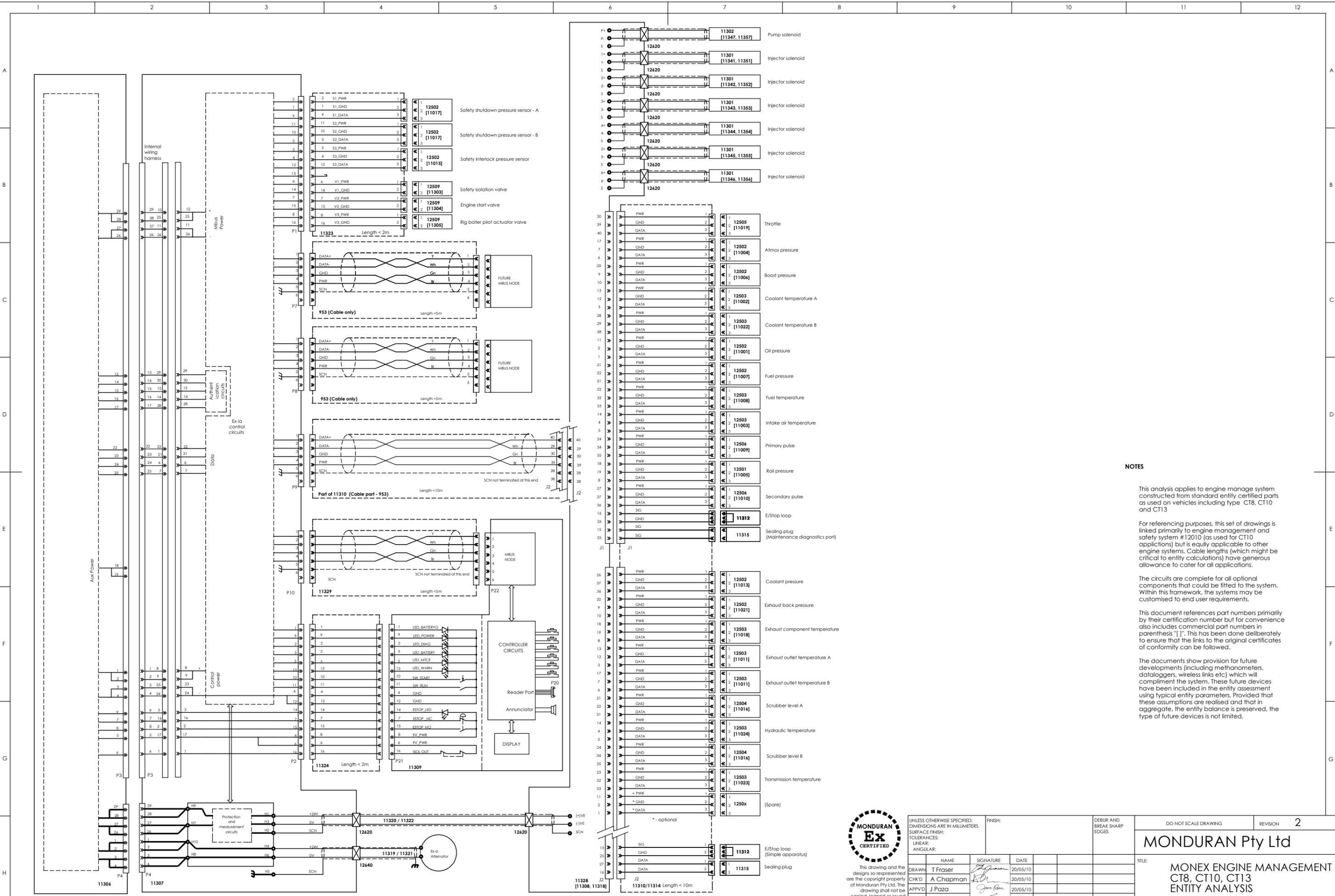
Clause AS/NZS 60079.25	Description	Complies			Comments
		YES	NO	N/A	
9.3	<p>Electrical parameters of cables</p> <p>The electrical parameters (<math>C_c</math> and <math>L_c</math> or <math>C_c</math> and <math>L_c/R_c</math>) for all cables used within an intrinsically safe system shall be determined according to a), b) or c):</p> <p>a) the most onerous electrical parameters provided by the cable manufacturer;</p> <p>b) electrical parameters determined by measurement of a sample, with the method of testing electrical parameters of cables given in Annex G;</p> <p>c) where the interconnection comprises two or three cores of a conventionally constructed cable (with or without screen): 200 pF/m and either 1 <math>\mu</math>H/m or an inductance to resistance ratio (<math>L_c/R_c</math>) calculated by dividing 1 <math>\mu</math>H by the manufacturers specified loop resistance per meter. Alternatively, for currents up to <math>I_o = 3</math> A an L/R ratio of 30 <math>\mu</math>H/<math>\Omega</math> may be used.</p> <p>Where a FISCO or FNICO system is used, the requirements for the cable parameters shall comply with Annex I.</p>	✓			Refer to the drawing 12010 Rev 2 "MONEX ENGINE MANAGEMENT CT8, CT10, CT13 ENTITY ANALYSIS" Sheet 11.
9.4	<p>Conducting Screens</p> <p>Where conducting screens provide protection for separate intrinsically safe circuits in order to prevent such circuits becoming connected to one another, the coverage of those screens shall be at least 60 % of the surface area.</p>			✓	
9.5	Types of multi-core cables	✓			Refer to the drawing 12010 Rev 2 "MONEX ENGINE MANAGEMENT CT8, CT10, CT13 ENTITY ANALYSIS" Sheet 11.
9.5.1	<p>General</p> <p>Multi-core cables shall be classified as either type A, type B or type C for the purposes of applying faults and assessing the safety of the cabling within an intrinsically safe system. The cable types are specified in 9.5.2, 9.5.3, and 9.5.4.</p> <p>The use of multi-core cables that do not comply with the requirements for types A, B, or C is not permitted.</p>	✓			
9.5.2	<p>Type A cable</p> <p>A cable whose construction complies with 9.1, 9.2, 9.3 and has conducting screens providing individual protection for each intrinsically safe circuit according to 9.4.</p>			✓	
9.5.3	<p>Type B cable</p> <p>A cable whose construction complies with 9.1, 9.2 and 9.3, is fixed and effectively protected against damage and does not contain any circuit with a maximum voltage <math>U</math> exceeding 60 V.</p>	✓			
9.5.4	<p>Type C cable</p> <p>A cable whose construction complies with 9.1, 9.2 and 9.3.</p>			✓	

Clause AS/NZS 60079.25	Description	Complies			Comments
		YES	NO	N/A	
<b>SECTION 10</b>	<p><b>Termination of intrinsically safe circuits</b></p> <p>Intrinsically safe systems that contain junction boxes or marshalling cubicles where intrinsically safe circuits are terminated shall comply with the terminal requirements in the facilities for the connection of external circuits of IEC 60079-11.</p>			✓	
<b>SECTION 11</b>	<p><b>Earthing and bonding of intrinsically safe systems</b></p> <p>In general, an intrinsically safe circuit shall either be fully floating or bonded to the reference potential associated with a hazardous area at one point only. The level of isolation required (except at that one point) is to be designed to withstand a 500 V insulation test in accordance with the dielectric strength requirement of IEC 60079-11. Where this requirement is not met, the circuit shall be considered to be earthed at that point. More than one earth connection is permitted on a circuit, provided that the circuit is galvanically separated into sub-circuits, each of which has only one earth point.</p> <p>Screens shall be connected to earth or the structure in accordance with IEC 60079-14. Where a system is intended for use in an installation where significant potential differences (greater than 10 V) between the structure and the circuit can occur, the preferred technique is to use a circuit galvanically isolated from external influences such as changes in ground potential at some distance from the structure. Particular care is required where part of the system is intended to be used in Zone 0 or Zone 20 locations or when the system has a very high level of protection so as to conform to EPL Ma requirements.</p> <p>The descriptive system document should clearly indicate which point or points of the system are intended to be connected to the plant reference potential and any special requirements of such a bond. This may be achieved by adding a reference to IEC 60079-14 in the descriptive system document.</p>	✓			The system uses galvanic isolation and does not require earthing or bonding for Ex protection.
<b>SECTION 12</b>	<p><b>Protection against lightning and other electrical surges</b></p> <p>Where a risk analysis shows that an installation is particularly susceptible to lightning or other surges, precautions shall be taken to avoid the possible hazards.</p> <p>.</p> <p>.</p> <p>.</p> <p>Intrinsically safe systems utilizing surge suppression techniques shall be supported by an adequately documented analysis of the effect of indirect multiple earthing, taking into account the criteria set out above. The capacitance and inductance of the surge suppression devices shall be considered in the assessment of the intrinsically safe system.</p>			✓	The system is installed on a mobile plant and as such does not present a possible hazard.
<b>SECTION 13</b>	<p><b>Assessment of an intrinsically safe system</b></p>				

Clause AS/NZS 60079.25	Description	Complies			Comments
		YES	NO	N/A	
13.1	<p><b>General</b></p> <p>Where a system contains apparatus which does not separately conform to IEC 60079-11, then that system shall be analysed as a whole, as if it were an apparatus. A level of protection "ia" system shall be analysed in accordance with the level of protection "ia" criteria of IEC 60079-11. A level of protection "ib" system shall be analysed in accordance with the level of protection "ib" criteria of IEC 60079-11. A level of protection "ic" system shall be analysed in accordance with the level of protection "ic" criteria of IEC 60079-11. In addition to the faults within the apparatus, the failures within the field wiring listed in 13.4 shall also be taken into account.</p> <p>Where all the necessary information is available, it is permissible to apply the fault count to the system as a whole even when apparatus conforming to IEC 60079-11 is being used. This is an alternative solution to the more usual straightforward comparison of input and output characteristics of the separately analysed or tested apparatus. Where a system contains only separately analysed or tested apparatus conforming to IEC 60079-11, the compatibility of all the apparatus included in the system shall be demonstrated. Faults within the apparatus have already been considered and no further consideration of these faults is necessary. Where a system contains a single source of power, the output parameters of the power source take into account opening, shorting and earthing of the external interconnecting cable, and consequently these failures do not need to be further considered. Annex A contains further details of the analysis of these simple circuits.</p> <p>When a system contains more than one linear source of power, then the effect of the combined sources of power shall be analysed. Annex B illustrates the analysis to be used in the most frequently occurring combinations.</p> <p>If an intrinsically safe system contains more than one source of power, and one or more of these sources are non-linear, the assessment method described in Annex B cannot be used. For this kind of intrinsically safe system, Annex C explains how the system analysis can be conducted if the combination contains a single non-linear power supply.</p>	✓			<p>The system uses separately Ex certified equipment. Refer to the drawing 12010 Rev 2 "MONEX ENGINE MANAGEMENT CT8, CT10, CT13 ENTITY ANALYSIS" for further information.</p>

Clause AS/NZS 60079.25	Description	Complies			Comments
		YES	NO	N/A	
13.2	<p>Simple apparatus</p> <p>Switches, terminals, terminal boxes, plugs and sockets complying with the simple apparatus requirements of IEC 60079-11, may be added to a system without modifying the safety assessment. The possible heating effects on simple apparatus shall be considered. When other types of simple apparatus consisting of energy storing components for example capacitors or inductors complying with IEC 60079-11 are added to a system, the safety assessment shall take into account their electrical parameters. A typical system using simple apparatus is shown in Figure 2.</p> <p>Where simple apparatus are intended to contain several separate intrinsically safe circuits, e.g. connectors, plugs and sockets or a resistance thermometer with two separate resistance windings, the separation requirements of IEC 60079-11 apply. If they do not conform, then the interconnected circuits shall be assessed as a single intrinsically safe circuit.</p>	✓			The system incorporates four in-line plug and socket arrangements that comply with the segregation and clearance requirements of IEC 60079-11:2011.
13.3	<p>Analysis of inductive circuits</p> <p>Where an apparatus has a well-defined inductance and resistance either by virtue of its documentation or construction, then the safety of the inductive aspects of the system shall be confirmed by the process defined in Annex D.</p>	✓			Refer to the drawing 12010 Rev 2 "MONEX ENGINE MANAGEMENT CT8, CT10, CT13 ENTITY ANALYSIS"
13.4	Faults in multi-core cables				
13.4.1	<p>Type of multi-core cables</p> <p>The faults, if any, which shall be taken into consideration in multi-core cables used within intrinsically safe electrical systems depend upon the type of cable used. The following sub-clauses detail the cable faults to be assessed for each type of cable.</p>	✓			
13.4.2	<p>Type A cable</p> <p>No faults between circuits shall be taken into consideration if the cable complies with 9.5.2.</p>			✓	
13.4.3	<p>Type B cable</p> <p>No faults between circuits shall be taken into consideration if the cable complies with 9.5.3.</p>	✓			
13.4.4	<p>Type C cable</p> <p>The combination of faults comprising of two short circuits between conductors and simultaneously up to four open circuits of conductors that result in the most onerous condition if the cable complies with 9.5.4.</p> <p>All circuits in a multi-core cable subject to damage shall adopt the level of protection of the circuit with the lowest level of protection.</p>			✓	
13.5	<p>Type verifications and type tests</p> <p>Where it is necessary to carry out type verifications and/or type tests to establish that a system is adequately safe, then the methods specified in IEC 60079-11 shall be used.</p>	✓			

Clause AS/NZS 60079.25	Description	Complies			Comments
		YES	NO	N/A	
<b>SECTION 14</b>	<p><b>Marking</b></p> <p>All apparatus within the system shall be readily identifiable. The minimum requirement is that the relevant descriptive system document shall be readily traceable. One acceptable technique is a clear instrument loop number, which identifies the loop documentation, which in turn lists the descriptive system document.</p> <p>Where a system is assessed as a whole and is found to conform to IEC 60079-11, each piece of apparatus shall be marked in accordance with that standard.</p>	✓			The injector solenoids (11301) and pump solenoid (11302) are adequately marked as per IEC 60079-0:2011, however they are not readily accessible due to being placed within the diesel engine assembly.
<b>SECTION 15</b>	<p><b>Predefined systems</b></p> <p>A system and all of its individual devices may be predefined and previously assessed in such a way that the interconnection of the individual devices and cables is sufficiently well known. In such cases, the assessment requirements of this standard can be simplified. One such predefined system is the FISCO system, the assessment of a FISCO system is set forth in Annex I.</p>			✓	



**NOTES**

This analysis applies to engine manage system constructed from standard entity certified parts as used on vehicles including type CT8, CT10 and CT13

For referencing purposes, this set of drawings is linked primarily to engine management and safety system #12010 (as used for CT10 applications) but is equally applicable to other engine systems. Cable lengths (which might be critical to entity calculations) have generous allowance to cater for all applications.

The circuits are complete for all optional components that could be fitted to the system. Within this framework, the systems may be customised to end user requirements.

This document references part numbers primarily by their certification number but for convenience also includes commercial part numbers in parenthesis "[ ]". This has been done deliberately to ensure that the links to the original certificates of conformity can be followed.

The documents show provision for future developments (including methanometers, dataloggers, wireless links etc) which will compliment the system. These future devices have been included in the entity assessment using typical entity parameters. Provided that these assumptions are realised and that in aggregate, the entity balance is preserved, the type of future devices is not limited.



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UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:	DEBUR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION 2
<b>MONDURAN Pty Ltd</b>					
TITLE: <b>MONEX ENGINE MANAGEMENT CT8, CT10, CT13 ENTITY ANALYSIS</b>					
DRAWN: T Fraser	SIGNATURE: [Signature]	DATE: 20/05/10		DWG NO. 12010	A2
CHKD: A Chapman	SIGNATURE: [Signature]	DATE: 20/05/10		EN_12010_Entity analysis_x	
APPVD: J Paza	SIGNATURE: [Signature]	DATE: 20/05/10			
MFG: N Hamidovic	SIGNATURE: [Signature]	DATE: 20/05/10			
G.A. A Chapman	SIGNATURE: [Signature]	DATE: 20/05/10			
Ex A Chapman	SIGNATURE: [Signature]	DATE: 20/05/10			
WEIGHT:			SCALE: 1:1 SHEET 1 OF 11		

References				1-2
11301	Injector solenoid	IECEX FTZU 08.0009X ANZEX 09.2010X	Ex mb I	Un : 70V In : 1A
11302	Pump solenoid	IECEX FTZU 08.0010X ANZEX 09.2003X		Un : 70V In : 0.38A

References				1-2	3-2
12501	Pressure sensor	IECEX FTZU 08.0011X ANZEX 09.2006X	Ex ia I	-20<Ta<125°C	Uo : 10.5V Io : 136mA Co : 30uF Lo : 3.5mH
12502	Temperature sensor				
12503	Level sensor	IECEX FTZU 08.0012X ANZEX 09.2005X			Ui : 10.5V Ci : 0uF Li : 0mH
12504	Throttle sensor	IECEX FTZU 08.0013X ANZEX 09.2008X			Uo : 10.5V Io : 216mA Co : 30uF Lo : 3.5mH
12505	Timing sensor	IECEX FTZU 08.0014X ANZEX 09.2007X			Ui : 10.5V Ci : 0uF Li : 0mH
12509	Plezo valve	IECEX FTZU 08.0016X ANZEX 09.2009X	Ex ia I/IIA T4	-20<Ta<60°C	Ui : 13.5V Ci : 0uF Li : 11uH

References				Power IN	Output solenoid (pump circuit)	Output solenoid (per injector circuit)	Mbus data	Mbus power	Sensors	Engine timing	E/S loop	Sensors	E/S loop	Engine comms	
				Terminals											
				(+) - (-)	P+ - P-	1+ - 1- 2+ - 2- 3+ - 3- 4+ - 4- 5+ - 5- 6+ - 6-	40-29	39-30	(Pwr)-(Com)-(Sig) 26-37-36 20-9-10 13-12-3 17-7-6 21-22-31 14-4-5 24-34-35 23-32-33 11-2-1	16-27	15-25	(Pwr)-(Com)-(Sig) 30-39-40 17-7-6 20-9-10 13-12-3 28-29-38 11-2-1 21-22-31 23-32-33 14-4-5 24-34-35 18-19-8 27-37-36	16-26	15-25	
11328	ECUEX	IECEX FTZU 09.0005X ANZEX 10.2004X	Ex mb e ib ia I	-20<Ta<40°C	U : 24V I : 10A	U : 70V I : 0.38A rms	U : 70V I : 1A rms	Uo : 10.5V Io : 0mA Co : 30uF Lo : 3.5mH  Ui : 10.5V Ci : 100nF Li : 0mH	Ui : 10.5V Ii : 2.84A Ci : 0uF Li : 0mH	Uo : 10.5V Io : 85mA Co : 30uF Lo : 3.5mH  Ui : 10.5V Ci : 0uF Li : 0mH	Uo : 10.5V Io : 167mA Co : 30uF Lo : 3.5mH	(Pwr)-(Com) Uo : 10.5V Io : 251mA Co : 30uF Lo : 3.5mH  (Sig)-(Com) Uo : 10.5V Io : 167mA Co : 30uF Lo : 3.5mH  Ui : 10.5V Ci : 0uF Li : 0mH	(Pwr)-(Com) Uo : 10.5V Io : 251mA Co : 30uF Lo : 3.5mH  (Sig)-(Com) Uo : 10.5V Io : 167mA Co : 30uF Lo : 3.5mH  Ui : 10.5V Ci : 0uF Li : 0mH	Uo : 10.5V Io : 167mA Co : 30uF Lo : 3.5mH  Ui : 10.5V Ci : 0uF Li : 0mH	
				When the energy source applied to POWER IN terminals is de-energised, all terminals are rated -Uo : 0V, Io : 0mA				The Ex ib terminals are galvanically isolated from all energy sources when input power is de-energised							

References				POWER OUT	POWER IN	POWER OUT	POWER OUT	POWER OUT	DATA	POWER IN	POWER IN
				P4		P3					
11306	Battery Module	IECEX FTZU 09.0003X ANZEX 10.2005X	Ex mb e ia I	-20<Ta<40°C	28/29-26/27	1/2-3/4	28/29-26/27	1/2-3/4	5-3/4	9-3/4	18/19-3/4
				Ex e	Ex e	Ex ia	Ex ia	Ex ia	Ex ia	Ex ia	Ex ia
				U : 24V I : 10A	U : 24V I : 20A	Uo : 10.5V Io : 2.84A Po : 7.46W Co : 15uF Lo : 80uH	Uo : 10.5V Io : 2.84A Po : 7.46W Co : 15uF Lo : 80uH	Uo : 10.5V Io : 59mA Co : 30uF Lo : 3.5mH	Uo : 10.5V Io : 59mA Co : 30uF Lo : 3.5mH	Ui : 10.5V Ii : 1.333mA Ci : 0uF Li : 0mH	Ui : 10.5V Ii : 1.333mA Ci : 0uF Li : 0mH

Reference				READER PORT	CONTROL/INDICATION PORT	MBUS PORT	
11309	Display module	IECEX FTZU 08.0015 ANZEX 10.2006	Ex ia I	-20<Ta<40°C	P20	P21	P22
				3-4	4/12-1 4/12-2 4/12-3 4/12-5 4/12-9 4/12-13 4/12-10 4/12-11 6-16 8-7 8-14 8-15	1-2	3-4
				Uo : 13.5V Io : 144mA Co : 1uF Lo : 3.5mH	Ui : 10.5V Ii : 100mA Ci : 0uF Li : 0uH	Ui : 10.5V Ii : 100nF Li : 0mH	Ui : 10.5V Ii : 2.8uH

References				Power IN	Power OUT	Valve power OUT	Sensor power OUT	Sensor signal	Control circuits				MBus power OUT	MBus data	POWER IN (Non isolated 9V control power)	POWER IN (Low power 9V)	DATA (Switches)	Data (Verify)	Data (SPI)	POWER OUT (E/S LED power)	POWER IN (Isolated MBUS Power)	POWER IN	POWER OUT			
				Terminals		P1		P2				P7...P10		P3				P4								
11307	Power distribution manager	IECEX FTZU 09.0004X ANZEX 10.2003X	Ex mb e ia I	-20<Ta<40°C	H4 (+) H5 (SCN) H6 (-)	H1 (+) H2 (SCN) H3 (-)	4/7/8-14 4/7/8-15 6/7/8-16	2-1/4/10 5-1/4/10 11-1/4/10	3-1/4/10 9-1/4/10 12-1/4/10	6/8-4/12	7-4/12 15-4/12 16-4/12	14-4/8	1-4/12 2-4/12 3-4/12 4-4/12 9-4/12 10-4/12 11-4/12 13-4/12	4-3	1-2	1/2-3/4	5-3/4	6-3/4 7-3/4 8-3/4 17-3/4	13-3/4 14-3/4 15-3/4 16-3/4 25-3/4	22-3/4 23-3/4 24-3/4	9-3/4	29/28-27/26	1/2-3/4	28/29-26/27		
				Ex e	Ex e	Ex ia		Ex ia				Ex ia		Ex ia				Ex e								
				U : 24V I : 20A	U : 24V I : 10A	Uo : 10.5V Io : 1.047A Co : 30uF Lo : 0.2mH	Uo : 10.5V Io : 313mA Co : 15uF Lo : 1mH	Ui : 10.5V Ii : 250mA Ci : 0uF Li : 0mH	Uo : 10.5V Io : 313mA Co : 15uF Lo : 1mH	Uo : 10.5V Io : 59mA Co : 30uF Lo : 3.5mH	Uo : 10.5V Io : 13mA Co : 30uF Lo : 3.5mH	Uo : 10.5V Io : 13mA Co : 30uF Lo : 3.5mH	Uo : 10.5V Io : 13mA Co : 30uF Lo : 3.5mH	Uo : 10.5V Io : 13mA Co : 30uF Lo : 3.5mH	Uo : 10.5V Io : 13mA Co : 30uF Lo : 3.5mH	Uo : 10.5V Io : 13mA Co : 30uF Lo : 3.5mH	Uo : 10.5V Io : 13mA Co : 30uF Lo : 3.5mH	Uo : 10.5V Io : 13mA Co : 30uF Lo : 3.5mH	Uo : 10.5V Io : 13mA Co : 30uF Lo : 3.5mH	Uo : 10.5V Io : 13mA Co : 30uF Lo : 3.5mH	Uo : 10.5V Io : 13mA Co : 30uF Lo : 3.5mH	Uo : 10.5V Io : 13mA Co : 30uF Lo : 3.5mH	Uo : 10.5V Io : 13mA Co : 30uF Lo : 3.5mH	Uo : 10.5V Io : 13mA Co : 30uF Lo : 3.5mH	Uo : 10.5V Io : 13mA Co : 30uF Lo : 3.5mH	Uo : 10.5V Io : 13mA Co : 30uF Lo : 3.5mH

**NOTES**  
Cable glands (#12620 and #12640) do not carry component certification but are approved for Ex e use under the certification for #11328 and #11307. The certification also allows for use of cable glands with component certification.  
The use of "" on the certificates of conformity indicates that the entity parameters depend on the connection of the module under consideration, to other modules with separate parameters. These tables indicate the specific instructions on the determination of the in a



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REVISION 2

MONDURAN Pty Ltd

TITLE: MONEX ENGINE MANAGEMENT C18, CT10, CT13 ENTITY ANALYSIS

DWG NO. 12010

A2

EN\_12010\_Entity analysis\_x

MATERIAL:

WEIGHT:

SCALE:1:1

SHEET 2 OF 11

**Mbus circuits (power)**

Mbus power is single-sourced from module 11307

Part Number	Description	Port	Terminals	Entity parameters				Notes
11307	Power manager module	P7, P8, P9, P10	4-3	Uo : 10.5V	Io : 2.84A	Co : 15uF	Lo : 80uH	Power source
11328	ECUEX module	J2	30-39	Ui : 10.5V	Ii : 2.84A	CI : 0uF	LI : 0uH	-
11309	Display module	P22	4-3	Ui : 10.5V	-	CI : 0uF	LI : 2.8uH	-
953 (future)	Cable	P7 - TBA	4-3	-	-	(C : 0.0007uF)	(L : 3.25uH)	Future cable - assume 5m
953 (future)	Cable	P8 - TBA	4-3	-	-	(C : 0.0007uF)	(L : 3.25uH)	Future cable - assume 5m
11310	Cable	P9-J2	4-3	-	-	C : 0.0007uF	L : 3.25uH	Actual installed cable length < 5m
11329	Cable	P10 - P22	4-3	-	-	C : 0.0014uF	L : 6.5uH	Factory preformed, length < 10m
TBA (future)	Mbus module	-	4-3	(Ui : 10.5V)	(-)	(CI : 0uF)	(LI : 2.8uH)	Future module - assume similar 11309
TBA (future)	Mbus module	-	4-3	(Ui : 10.5V)	(-)	(CI : 0uF)	(LI : 2.8uH)	Future module - assume similar 11309
TOTAL				-	-	$\Sigma Ci = 0.0021uF$ (Future $\Sigma Ci = 0.0035uF$ )	$\Sigma Li = 12.55uH$ (Future $\Sigma Li = 24.25uH$ )	Parameters shown in parenthesis () are typical for future components
Assessment AS INSTALLED				Compliant 10.5V = 10.5V The source voltage does not exceed the load parameters	Compliant 2.84A = 2.84A The rated load current is not exceeded by rated source current	Compliant 0.0021uF < 15uF The capacitive load does not exceed the source rating	Compliant 12.55uH < 80uH The inductive load does not exceed the source rating	Compliance for all parameters, both as installed and as proposed for future modules (with margin)
Assessment as proposed for FUTURE						Compliant 0.0035uF < 15uF The capacitive load does not exceed the source rating	Compliant 24.25uH < 80uH The inductive load does not exceed the source rating	

**Mbus circuits (signals)**

The Mbus nodes (module 11328, 11307, 11309 and future) are independently capable of acting as a power source. This analysis is presented with module 11307 as the single source. The analysis is equally applicable with other modules as single sources. The case of multiple sources is readily extrapolated from the analysis.

Part Number	Description	Port	Terminals	Entity parameters				Notes
11307	Power manager module	P7, P8, P9, P10	1-2	Uo : 10.5V	Io : 0A	Co : 30uF	Lo : 3.5mH	Budget parameters from Mbus power supply
11328	ECUEX module	J2	40-29	Ui : 10.5V	-	CI : 0.1uF	LI : 0mH	-
11309	Display module	P22	1-2	Ui : 10.5V	-	CI : 0.1uF	LI : 0mH	-
953 (future)	Cable	P7 - TBA	1-2	-	-	(C : 0.0007uF)	(L : 0.00325mH)	Future cable - assume 5m
953 (future)	Cable	P8 - TBA	1-2	-	-	(C : 0.0007uF)	(L : 0.00325mH)	Future cable - assume 5m
11310	Cable	P9-J2	1-2	-	-	C : 0.0014uF	L : 0.0065mH	Factory preformed, length < 10m
11329	Cable	P10 - P22	1-2	-	-	C : 0.0007uF	L : 0.00325mH	Factory preformed, length < 5m
TBA (future)	Mbus module	-	(1-2)	(Ui : 10.5V)	-	(CI : 0.1uF)	(LI : 0mH)	Future module - assume similar 11309
TBA (future)	Mbus module	-	(1-2)	(Ui : 10.5V)	-	(CI : 0.1uF)	(LI : 0mH)	Future module - assume similar 11309
TOTAL				-	-	$\Sigma Ci = 0.2021uF$ (Future $\Sigma Ci = 0.4035uF$ )	$\Sigma Li = 0.00975mH$ (Future $\Sigma Li = 0.01625mH$ )	Parameters shown in parenthesis () are typical for future components
Assessment AS INSTALLED				Compliant 10.5V = 10.5V The source voltage does not exceed the load parameters. Compliance is unchanged when more than one node is acting as a source.	Compliant The current into the loads is defined by the applied voltage and is not limited by rating. Compliance is unchanged when more than one node is acting as a source.	Compliant 0.2021uF < 15uF The capacitive load does not exceed the source rating. The single source condition describes the worst case analysis for capacitive load and does not affect compliance.	Compliant 0.00975mH < 3.5mH The inductive load does not exceed the source rating. The single source condition describes the worst case analysis for inductive load and does not affect compliance.	Installed system is compliant for all parameters under all cases of single or multiple sources. Compliance is not affected by system options or proposed future modules.
Assessment as proposed for FUTURE						Compliant 0.4035uF < 15uF The capacitive load does not exceed the source rating. The single source condition describes the worst case analysis for capacitive load and does not affect compliance.	Compliant 0.01625mH < 3.5mH The inductive load does not exceed the source rating. The single source condition describes the worst case analysis for inductive load and does not affect compliance.	



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LINEAR:						DWG NO. 12010		A3	
ANGULAR:						FILE EN_12010_Entity analysis_x		SCALE:1:1 SHEET 3 OF 11	
NAME	SIGNATURE	DATE				MATERIAL:			
DRAWN: T Fraser	<i>T Fraser</i>	20/05/10							
CHK'D: A Chapman	<i>A Chapman</i>	20/05/10							
ENG: J Paza	<i>J Paza</i>	20/05/10							
MFG: N Hamidovic	<i>N Hamidovic</i>	20/05/10							
Q.A: A Chapman	<i>A Chapman</i>	20/05/10							
Ex: A Chapman	<i>A Chapman</i>	20/05/10							

**Switch circuits (control)**

Part Number	Description	Port	Terminals	Entity Parameters				Notes
11306	Battery module	P3	6-3/4 7-3/4 8-3/4	Uo: 9.56V	Io : 26mA	Co : 30uF	Lo : 3.5mH	Budget source parameters
11307	Power manager module	P3	6-3/4 7-3/4 8-3/4	Ui : 10.5V	Ii : 26mA	Ci : 0uF (See notes)	Li = 0mH (See notes)	Ci : (Algebraic sum of all capacitance connected at P2 terminals 7-4/12, 15-4/12 or 16-4/12). Let Ci=0mF, since capacitance from 11309 and 11324 is separately accounted for in the summation. Li : (Algebraic sum of all inductance connected at P2 terminals 7-4/12, 15-4/12 or 16-4/12). Let Li=0mH, since inductance from 11309 and 11324 is separately accounted for in the summation.
11307	Power manager module	P2	7-4/12 15-4/12 16-4/12	Uo : 10.5V	Io : 26mA	See note	See note	Co : (Co of any equipment connected to connector P2 terminals 7-4/12, 15-4/12, or 16-4/12). Co is not a specified parameter for 11309 since it is not a power source. Hence Co=Null Lo : (Lo of any equipment connected to connector P2 terminals 7-4/12, 15-4/12, or 16-4/12). Lo is not a specified parameter for 11309 since it is not a power source. Hence Lo=Null
11324	Cable	P2-P21	7-4/12 15-4/12 16-4/12	-	-	C : 0.00028uF	L : 0.0013mH	Factory preformed, length < 2m
11309	Display module	P21	7-4/12 15-4/12 16-4/12	Ui: 10.5V	Ii: 100mA	Ci : 0mF	Li : 0mH	The circuits have load parameters only
Assessment AS INSTALLED				Compliant 10.5V > 9.56V The voltage rating of the load exceeds the source voltage	Compliant 26mA = 26mA 26mA < 100mA The source current does not exceed the maximum load current	Compliant 0.00028uF < 30uF The capacitive load does not exceed the source rating	Compliant 0.0013mH < 3.5mH The inductive load does not exceed the source rating	Installed system is compliant for all parameters. Compliance is not affected by system options or proposed future modules.

**Switch circuits (power)**

Part Number	Description	Port	Terminal	Entity Parameters				Notes
11306	Battery module	P3	5-3/4	Uo: 10.5V	Io : 59mA	Co : 30uF	Lo : 3.5mH	Budget source parameters
11307	Power manager module	P3	5-3/4	Ui : 10.5V	Ii : 59mA	Ci : 0uF	Li = 0mH	Ci : (Algebraic summation of all capacitance connected at P2 terminals 6/8-4/12, Hence Ci = 0uF Li : (Algebraic sum of all inductance connected at P2 terminals 6/8-4/12). Hence Li = 0mH
11324	Cable	P2 - P21	6/8-4/12	-	-	C : 0.00028uF	L : 0.0013mH	Factory preformed, length < 2m
11309	Display module	P21	6-16 8-15 8-14 8-7	Ui : 10.5V	Ii : 100mA	Ci : 0uF	Li = 0mH	-
Assessment AS INSTALLED				Compliant 10.5V = 10.5V The voltage rating of the loads match the source voltage	Compliant 59mA < 100mA 59mA = 59mA The current rating of the loads is not exceeded by the source rating	Compliant 0.00028uF < 30uF The capacitive load does not exceed the source rating	Compliant 0.0013mH < 3.5mH The inductive load does not exceed the source rating	Installed system compliant for all parameters. Compliance is not affected by system options or proposed future modules.

**Aux Power IN**

The auxiliary power circuit is for maintenance purposes only and does not have an operational function. The port is sealed by the P3 mating connector on 11307. The circuit does not extend past the pins on P3, 11306.

Part Number	Description	Port	Terminal	Entity Parameters				Notes
11306	Battery module	P3	18/19-3/4	Ui: 10.5V	Ii : 1.333A	Ci : 0uF	Li : 0mH	-
Assessment AS INSTALLED				Compliant Nil electrical connection	Installed system compliant for all parameters. Compliance is not affected by system options or proposed future modules.			



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**Control circuits**

Part Number	Description	Port	Terminal	Entity Parameters				Notes
11307	Power manager module	P2	1-4/12 2-4/12 3/4/12 5-4/12 9-4/12 10-4/12 11-4/12 13-4/12	Uo : 10.5V	Io : 15mA	Co: 30uF	Lo = 3.5mH	Co : (Co of any equipment connected to connector P2 terminals 14-6/8). Hence Co = 0uF. Lo : (Lo of any equipment connected to connector P2 terminals 14-6/8, less any connecting capacitance). Hence Lo = 0mH
11324	Cable	P2 - P21	1-4/12 2-4/12 3/4/12 5-4/12 9-4/12 10-4/12 11-4/12 13-4/12	-	-	C : 0.00028uF	L : 0.0013mH	Factory preformed, length < 2m
11309	Display module	P21	1-4/12 2-4/12 3/4/12 5-4/12 9-4/12 10-4/12 11-4/12 13-4/12	Ui : 10.5V	Ii : 100mA	Ci : 0uF	Li = 0mH	-
Assessment AS INSTALLED				Compliant 10.5V = 10.5V The voltage rating of the load matches the source voltage	Compliant 15mA < 100mA The current rating of the load is not exceeded by the source rating	Compliant 0.0028uF < 30uF The capacitive load does not exceed the source rating	Compliant 0.0013mH < 3.5mH The inductive load does not exceed the source rating	Compliance for all parameters as installed. Compliance is not affected by system options or proposed future modules.

**E/S switch power circuit**

Part Number	Description	Port	Terminal	Entity Parameters				Notes
11306	Battery module	P3	5-3/4	Uo : 10.5V	Io : 59mA	Co : 30uF	Lo : 3.5mH	
11307	Power manager module	P3	5-3/4	Ui : 10.5V	Ii : 59mA	Ci : 0uF	Li = 0mH	Ci : (Algebraic summation of all capacitance connected at P2 terminals 6/8-4/12, Hence Ci = 0uF Li : (Algebraic sum of all inductance connected at P2 terminals 6/8-4/12). Hence Li = 0mH
11324	Cable	P2 - P21	-	-	-	C : 0.00028uF	L : 0.0013mH	Factory preformed, length < 2m
11309	Display module	P21	4/12-1 4/12-2 4/12-3 4/12-5 4/12-9 4/12-13 4/12-10 4/12-11 6-16 8-7 8-14 8-15	Ui : 10.5V	Ii : 100mA	Ci : 0uF	Li = 0mH	-
Assessment AS INSTALLED				Compliant 10.5V = 10.5V The voltage rating of the load matches the source voltage	Compliant 59mA = 59mA 59mA < 100mA The current rating of the load is not exceeded by the source rating	Compliant 0.0028uF < 30uF The capacitive load does not exceed the source rating	Compliant 0.0013mH < 3.5mH The inductive load does not exceed the source rating	The assessment includes consideration of 11307 which is passive. Power is derived from 11306 and the load is in 11309. Installed system compliant for all parameters. Compliance is not affected by system options or proposed future modules.

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				FILE: EN_12010_Entity analysis_x	SCALE:1:1 SHEET 4 OF 11																					

**Authentication circuits**

Power is sourced from 11306. Module 11307 can only behave as a source by returning received power.

Part Number	Description	Port	Terminals	Entity Parameters							Notes
11306	Battery module	P3	13-3/4 14-3/4 15-3/4 16-3/4 17-3/4	Uo : 9.56V	Io : 26mA	Co : 30uF	Lo : 3.5mH	Ui : 10.5V	Ci : 0uF	Li : 0mH	-
11307	Power manager module	P3	13-3/4 14-3/4 15-3/4 16-3/4 17-3/4	Ui : 10.5V	-	Ci : 0.5uF	Li = 0mH	Uo : 10.5V	Co : 30uF	Lo : 3.5mH	-
Assessment AS INSTALLED				Compliant 10.5V > 9.56V The voltage rating of the load exceeds the source voltage	Compliant The input currents are defined by applied voltage and are not limiting	Compliant 0.5uF < 30uF The capacitive load does not exceed the source rating	Compliant 0mH < 3.5mH The inductive load does not exceed the source rating	Compliant 10.5V = 10.5V The voltage rating of the load matches the source voltage	Compliant 0uF < 30uF The capacitive load does not exceed the source rating	Compliant 0mH < 3.5mH The inductive load does not exceed the source rating	Installed system compliant for all parameters. Compliance is not affected by system options or proposed future modules.

**Data communication circuits**

Power can be sourced from either module 11306 or 11307.

Part Number	Description	Port	Terminals	Entity Parameters							Notes	
11306	Battery module	P3	22-3/4 23-3/4 24-3/4 25-3/4	Uo : 9.56V	Io : 26mA	Co : 30uF	Lo : 3.5mH	Ui : 10.5V	-	Ci : 0uF	Li : 0mH	-
11307	Power manager module	P3	22-3/4 23-3/4 24-3/4 25-3/4	Ui : 10.5V	-	Ci : 13.6uF	Li = 0mH	Uo : 10.5V	Io : 30mA	Co : 30uF	Lo : 3.5mH	-
Assessment AS INSTALLED				Compliant 10.5V > 9.56V The voltage rating of the load exceeds the source voltage	Compliant The input currents are defined by applied voltage and are not limiting	Compliant 13.6uF < 30uF The capacitive load does not exceed the source rating	Compliant 0mH < 3.5mH The inductive load does not exceed the source rating	Compliant 10.5V = 10.5V The voltage rating of the load matches the source voltage	Compliant The input currents are defined by applied voltage and are not limiting	Compliant 0uF < 30uF The capacitive load does not exceed the source rating	Compliant 0mH < 3.5mH The inductive load does not exceed the source rating	Installed system compliant for all parameters. Compliance is not affected by system options or proposed future modules.

**LED power circuit**

The assessment includes consideration of 11307 which is passive. Power is derived from 11306 and the load is in 11309.

Part Number	Description	Port	Terminal	Entity Parameters				Notes
11306	Battery module	P3	9-3/4	Ui : 10.5V	Ii : 59mA	Ci : 0uF	Li : 0mH	
11307	Power manager module	P3	9-3/4	Uo : 10.5V	Io : 59mA	Co : 30uF	Lo : 3.5mH	Co : (Co of any equipment connected to connector P2 terminals 14-6/8). 11309 is a load device and the terminals under consideration do not have a rated Co. Power is derived from 11306 Pins 5-3/4 where Co = 30uF Lo : (Lo of any equipment connected to connector P2 terminals 14-6/8, less any connecting capacitance). 11309 is a load device and the terminals under consideration do not have a rated Lo. Power is derived from 11306 Pins 5-3/4 where Lo = 3.5mH
11307	Power manager module	P2	14-6/8	Ui : 10.5V	Ii : 59mA	Ci : 0uF	Li = 0mH	Ci : (Algebraic sum of all capacitance connected at P3 terminals 9-3/4). For 11306, Ci = 0uF, hence Ci : 0uF Li : (Algebraic sum of all inductance connected at P3 terminals 9-3/4). For 11306, Li = 0mH, hence Li : 0mH
11324	Cable	P2 - P21	14-6/8	-	-	C : 0.00028uF	L : 0.0013mH	Factory preformed, length < 2m
11309	Display module	P21	4/12-1 4/12-2 4/12-3 4/12-5 4/12-9 4/12-13 4/12-10 4/12-11 6-16 8-7 8-14 8-15	Ui : 10.5V	Ii : 100mA	Ci : 0uF	Li = 0mH	-
Assessment AS INSTALLED				Compliant 10.5V = 10.5V The voltage rating of the load matches the source voltage	Compliant 59mA = 59mA 59mA < 100mA The current rating of the load is not exceeded by the source rating	Compliant 0.0028uF < 30uF The capacitive load does not exceed the source rating	Compliant 0.0013mH < 3.5mH The inductive load does not exceed the source rating	Compliance for all parameters as installed. Compliance is not affected by system options or proposed future modules.



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**Control valve circuits**

Power for the circuits can only be derived from the 11307 module.

Part Number	Description	Port	Terminal	EntityParameters				Notes
11307	Power manager module	P1	6/7/8-14 6/7/8-15 6/7/8-16	Uo : 10.5V	Io : 1.047A	Co : 30uF	Lo = 0.2mH	Source parameters
11323	Cable	P1	-	-	-	C : 0.0028uF	L : 0.0013mH	Factory preformed, length < 2m
12509	Piezo valve	-	1-2	Ui : 13.5V	-	Ci : 0uF	Li : 0.011mH	
Assessment AS INSTALLED				Compliant 13.5V > 10.5V The voltage rating of the load exceeds the rated source voltage	Compliant The input current is define by the applied voltage, without current limitation	Compliant 0.0028uF < 30uF The capacitive load does not exceed the source rating	Compliant 0.0123mH < 0.2mH The inductive load does not exceed the source rating	Installed system compliant for all parameters. Compliance is not affected by system options or proposed future modules.

**Sensor circuits (power)**

Power for the circuits can only be derived from the 11307 module.

Part Number	Description	Port	Terminal	EntityParameters				Notes
11307	Power manager module	P1	2-1/4/10 5-1/4/10 11-1/4/10	Uo : 10.5V	Io : 313mA	Co : 15uF	Lo = 1mH	Source parameters
11323	Cable	P1	-	-	-	C : 0.0028uF	L : 0.0013mH	Factory preformed, length < 2m
12502	Pressure sensor	-	1-2	Ui : 10.5V	-	Ci : 0uF	Li : 0mH	
Assessment AS INSTALLED				Compliant 10.5V = 10.5V The voltage rating of the load matches the rated source voltage	Compliant The input current is define by the applied voltage, without current limitation	Compliant 0.0028uF < 15uF The capacitive load does not exceed the source rating	Compliant 0.0013mH < 1mH The inductive load does not exceed the source rating	Installed system compliant for all parameters. Compliance is not affected by system options or proposed future modules.

**Sensor circuits (signals)**

The signal circuits can behave as both a source of power and a load.

Part Number	Description	Port	Terminal	EntityParameters								Notes
12502	Pressure sensor	-	3-2	Ui : 10.5V	-	Ci : 0uF	Li : 0mH	Uo : 10.5V	Io : 136mA	Co : 30uF	Lo : 3.5mH	-
11307	Power manager module	P1	3-1/4/10 9-1/4/10 12-1/4/10	Uo : 10.5V	Io : 313mA	Co : 15uF	Lo = 1mH	Ui : 10.5V	Ii : 250mA	Ci : 0uF	Li : 0mH	-
11323	Cable	P1	-	-	-	C : 0.0028uF	L : 0.0013mH	-	-	C : 0.0028uF	L : 0.0013mH	Factory preformed, length < 2m
Assessment AS INSTALLED				Compliant 10.5V = 10.5V The voltage rating of the load matches the rated source voltage	Compliant The input current is define by the applied voltage, without current limitation	Compliant 0.0028uF < 15uF The capacitive load does not exceed the source rating	Compliant 0.0013mH < 1mH The inductive load does not exceed the source rating	Compliant 10.5V = 10.5V The voltage rating of the load matches the rated source voltage	Compliant 250mA > 136mA The current rating of the load is not exceeded by the source rating	Compliant 0.0028uF < 15uF The capacitive load does not exceed the source rating	Compliant 0.0013mH < 3.5mH The inductive load does not exceed the source rating	Installed system compliant for all parameters. Compliance is not affected by system options or proposed future modules.



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**Mbus power circuits**

Part Number	Description	Port	Terminals	Entity Parameters					Notes
11306	Battery module	P3	28/29-27/26	Po : 7.46W	Uo: 10.5V	Io : 2.84A	Co : 15uF	Lo : 80uH	Source parameters
11307	Power manager module	P3	28/29-27/26	Pi : 7.46W	Ui : 10.5V	Ii : 2.84A	$\Sigma Ci = 0.0021\mu F$ (Future $\Sigma Ci = 0.0035\mu F$ )	$\Sigma Li = 12.55\mu H$ (Future $\Sigma Li = 24.25\mu H$ )	Ci : (Algebraic summation of all capacitance connected at P7, P8, P9, P10 terminals 1-2) Li : (Algebraic summation of all inductance connected at P7, P8, P9, P10 terminals 1-2) See sheet 3
Assessment AS INSTALLED				Compliant 7.46W = 7.46W The power rating of the load is matched by the source	Compliant 10.5V = 10.5V The voltage rating of the load matches the source voltage	Compliant 2.84A = 2.84A The current rating of the load is matched at source	Compliant 0.0021uF < 15uF The capacitive load does not exceed the source rating	Compliant 12.55uH < 80uH The inductive load does not exceed the source rating	Compliance for all parameters, both as installed and as proposed for future modules (with margin)
Assessment as proposed for FUTURE							Compliant 0.0035uF < 15uF The capacitive load does not exceed the source rating	Compliant 24.25uH < 80uH The inductive load does not exceed the source rating	

**Control power circuits**

Part Number	Description	Port	Terminal	Entity Parameters					Notes
11306	Battery module	P3	1/2-3/4	Po : 7.46W	Uo: 10.5V	Io : 2.84A	Co : 15uF	Lo : 80uH	Source parameters
11307	Power manager module	P3	1/2-3/4	Pi : 7.46W	Ui : 10.5V	Ii : 2.84A	Ci : 13.6uF	Li = 0uH	Load parameters
Assessment AS INSTALLED				Compliant 7.46W = 7.46W The power rating of the load is matched by the source	Compliant 10.5V = 10.5V The voltage rating of the load matches the source voltage	Compliant 2.84A = 2.84A The current rating of the load is matched at source	Compliant 13.6uF < 15uF The capacitive load does not exceed the source rating	Compliant 0uH < 80uH The inductive load does not exceed the source rating	Installed system compliant for all parameters. Compliance is not affected by system options or proposed future modules.

**FOB key circuits**

The FOB modules (980 and 981) are certified under module 11309

Part Number	Description	Port	Terminal	Entity parameters				Notes
11309	Display module	P20	3-4	Uo: 13.5V	Io : 144mA	Co : 1uF	Lo : 3.5mH	Source parameters
980 981	FOB modules	-	-	-	-	C : 0.005uF	L = 0uH	Load parameters
Assessment AS INSTALLED				Compliant The FOBs are certified under 11309	Compliant The FOBs are certified under 11309	Compliant The source rating is not exceeded by the load capacitance	Compliant The source rating is not exceeded by the load inductance	Installed system compliant for all parameters. Compliance is not affected by system options or proposed future modules.



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**Engine sensor circuits (signals)**

The signal circuits can behave as both a source of power and a load.

Part Number	Description	Port	Terminal	EntityParameters								Notes
12501 12502 12503 12504 12505	Sensors	-	3-2	Ui : 10.5V	-	Ci : 0uF	Li : 0mH	Uo : 10.5V	Io : 136mA	Co : 30uF	Lo : 3.5mH	-
12506	Sensor (speed)	-	3-2	Ui : 10.5V	-	Ci : 0uF	Li : 0mH	Uo : 10.5V	Io : 216mA	Co : 30uF		-
11328	ECUEx module	J1 J2	(Pwr)-(Com)-(Sig) 26-37-36 20-9-10 18-19-8 13-12-3 17-7-6 21-22-31 14-4-5 24-34-35 23-32-33 11-2-1 (Pwr)-(Com)-(Sig) 30-39-40 17-7-6 20-9-10 13-12-3 28-29-38 11-2-1 21-22-31 23-32-33 14-4-5 24-34-35 18-19-8 27-37-36	Uo : 10.5V	Io : 167mA	Co : 30uF	Lo = 3.5mH	Ui : 10.5V	-	Ci : 0uF	Li : 0mH	
11310	Cable	J1 J2	-	-	-	C : 0.0014uF	L : 0.0065mH	-	-	C : 0.0014uF	L : 0.0065mH	Factory preformed, length < 10m
Assessment AS INSTALLED (including 12501..12506)				Compliant 10.5V = 10.5V The voltage rating of the load matches the rated source voltage	Compliant The input current is define by the applied voltage, without current limitation	Compliant 0.0014uF<30uF The capacitive load does not exceed the source rating	Compliant 0.0065mH<3.5mH The inductive load does not exceed the source rating	Compliant 10.5V = 10.5V The voltage rating of the load matches the rated source voltage	Compliant The input current is define by the applied voltage, without current limitation	Compliant 0.0014uF<30uF The capacitive load does not exceed the source rating	Compliant 0.0065mH<3.5mH The inductive load does not exceed the source rating	Installed system is compliant for all parameters. Compliance is not affected by system options or proposed future modules.

**Engine sensor circuits (power)**

Power for the circuits can only be derived from the 11328 module.

Part Number	Description	Port	Terminal	EntityParameters				Notes
11328	ECUEx module	J1 J2	(Pwr)-(Com)-(Sig) 26-37-36 20-9-10 18-19-8 13-12-3 17-7-6 21-22-31 14-4-5 24-34-35 23-32-33 11-2-1 (Pwr)-(Com)-(Sig) 30-39-40 17-7-6 20-9-10 13-12-3 28-29-38 11-2-1 21-22-31 23-32-33 14-4-5 24-34-35 18-19-8 27-37-36	Uo : 10.5V	Io : 251mA	Co : 30uF	Lo = 3.5mH	Source parameters
11310	Cable	J1 J2	-	-	-	C : 0.0014uF	L : 0.0065mH	Fctory preformed, length < 10m
12501 12502 12503 12504 12505 12506	Sensors	-	1-2	Ui : 10.5V	-	Ci : 0uF	Li : 0mH	
Assessment AS INSTALLED				Compliant 10.5V = 10.5V The voltage rating of the load matches the rated source voltage	Compliant The input current is define by the applied voltage, without current limitation	Compliant 0.0014uF<15uF The capacitive load does not exceed the source rating	Compliant 0.0065mH<3.5mH The inductive load does not exceed the source rating	Installed system compliant for all parameters. Compliance is not affected by system options or proposed future modules.



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**Engine maintenance circuits**

The signal circuits can behave as both a source of power and a load. The port is sealed with a mechanical (non electrical) seal.

Part Number	Description	Port	Terminal	EntityParameters							Notes
11328	ECUEx module	J1	15-25	Uo : 10.5V	Io : 167mA	Co : 30uF	Lo = 3.5mH	Ui : 10.5V	CI : 0uF	Li : 0mH	-
11315	Sealing plug	-	1-2	See note	See note	See note	See note	-	-	-	#11315 is a sealing cap with no electrical circuits. The port is used for maintenance purposes for communicating with the OEM engine controller. The port is not intended to be used in hazardous areas, but nonetheless is explosion protected.
Assessment AS INSTALLED				Compliant The load is a non-electrical device. Voltage matching is not a requirement.	Compliant The load is a non-electrical device. Current matching is not a requirement.	Compliant The load is a non-electrical device with negligible capacitance	Compliant The load is a non-electrical device with negligible inductance	Compliant The port is not intended for operational use	Compliant The port is not intended for operational use	Compliant The port is not intended for operational use	Installed system compliant for all parameters. Compliance is not affected by system options or proposed future modules.

**Emergency stop loop circuits**

Power for the circuits can only be derived from the 11328 module.

Part Number	Description	Port	Terminal	EntityParameters				Notes
11328	ECUEx module	J1 J2	16-26 15-25	Uo : 10.5V	Io : 167mA	Co : 30uF	Lo = 3.5mH	Source parameters
11312	E/S loop	-	1-2	See note	See note	CI : 0uF	Li : 0mH	#11312 is a passive simple device with no entity parameters. In normal operation the current through the loop is ~0.5mA at 3.3V. The energy in the loop circuit is limited to safe levels by the barriers in 11328.
Assessment AS INSTALLED				Compliant The load is a simple device. Voltage matching is not a requirement.	Compliant The load is a simple device. Current matching is not a requirement.	Compliant The load is a simple device with negligible capacitance	Compliant The load is a simple device with negligible inductance	Installed system compliant for all parameters. Compliance is not affected by system options or proposed future modules.

**Engine timing circuits**

Power for the circuits can only be derived from the 11328 module. The circuits are for maintenance purposes only and not for operational use.

Part Number	Description	Port	Terminal	EntityParameters							Notes
11328	ECUEx module	J2	16-27	Uo : 10.5V	Io : 167mA	Co : 30uF	Lo = 3.5mH	Ui : 10.5V	CI : 0uF	Li : 0mH	Source parameters
11315	Sealing cap	-	1-2	See note	See note	See note	See note	-	-	-	#11315 is a sealing cap with no electrical circuits. The port is used for maintenance purposes for timing the OEM engine controller. The port is not intended to be used in hazardous areas, but nonetheless is explosion protected.
Assessment AS INSTALLED				Compliant The load is a non-electrical device. Voltage matching is not a requirement.	Compliant The load is a non-electrical device. Current matching is not a requirement.	Compliant The load is a non-electrical device with negligible capacitance	Compliant The load is a non-electrical device with negligible inductance	Compliant The load is a non-electrical device. Voltage matching is not a requirement.	Compliant The port is not intended for operational use	Compliant The port is not intended for operational use	Installed system compliant for all parameters. Compliance is not affected by system options or proposed future modules.



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**Injector solenoid power circuits**

Part Number	Description	Port	Terminal	Parameters		Notes
11328	ECUEX module	-	1+ - 1- 2+ - 2- 3+ - 3- 4+ - 4- 5+ - 5- 6+ - 6-	Un : 70V	In : 1A	Ex e terminals
11301	Injector solenoid component	Cable tail (integral to component)		U : 70V	I : 1A	Ex e terminals
Assessment AS INSTALLED				Compliant 70V=70V The rated load voltage matches the rated source voltage.	Compliant 1A=1A The rated load current matches the rated source current.	Installed system is compliant for all parameters. Compliance is not affected by system options or proposed future modules.

**Pump solenoid power circuits**

Part Number	Description	Port	Terminal	Parameters		Notes
11328	ECUEX module	-	P+ - P-	Un : 70V	In : 0.38A	Ex e terminals
11302	Pump solenoid component	Cable tail (integral to component)		U : 70V	I : 0.38A	Ex e terminals
Assessment AS INSTALLED				Compliant 70V=70V The rated load voltage matches the rated source voltage.	Compliant 0.38A>0.38A The rated load current matches the rated source current.	Installed system is compliant for all parameters. Compliance is not affected by system options or proposed future modules.

**Non-IS power circuits (11319 Power manager - ECUEX)**

Part Number	Description	Port	Terminal	EntityParameters		Notes
11307	Power manager module	POWER OUT	H1-H3	Un : 24V	In : 10A	Ex mb
11328	ECUEX module	POWER IN	(+) - (-)	Un : 24V	In : 10A	Ex mb
Assessment AS INSTALLED				Compliant 24V=24V The rated load voltage matches the rated source voltage.	Compliant 10A = 10A The rated load current matches the rated source current.	Installed system compliant for all parameters. Compliance is not affected by system options or proposed future modules.

**Non-IS power circuits (11320 Alternator - Power manager)**

Part Number	Description	Port	Terminal	Parameters		Notes
11307	Power manager module	POWER IN	H4-H6	Un : 24V	In : 20A	Ex mb
-	Alternator	POWER OUT	(+) - (-)	U : 18.6V	I : 12A	Ex d The alternator is rated 20A, 24V. The max input into #11307 is set by the alternator protection U = 18.6V I o/c = 12A for 1 s
Assessment AS INSTALLED				Compliant 24V>18.6V The rated load voltage does not exceed the rated source voltage.	Compliant 20A>12A The rated load current is not exceeded by the rated source current.	Installed system compliant for all parameters. Compliance is not affected by system options or proposed future modules.

**Non-IS power circuits connectors**

Part Number	Description	Port	Terminal	Parameters		Notes
11307	Power manager module	P4	28/29-26/27	Un : 24V	In : 10A	Ex e
11306	Battery module	P4	28/29-26/27	U : 24V	I : 10A	Ex e
Assessment AS INSTALLED				Compliant 24V=24V The rated load voltage matches the rated source voltage.	Compliant 10A=10A The rated load current matches the rated source current.	Installed system is compliant for all parameters. Compliance is not affected by system options or proposed future modules.

**Non-IS power circuits connectors**

Part Number	Description	Port	Terminal	Parameters		Notes
11307	Power manager module	P4	1/2-3/4	Un : 24V	In : 20A	Ex e
11306	Battery module	P4	1/2-3/4	U : 24V	I : 20A	Ex e
Assessment AS INSTALLED				Compliant 24V=24V The rated load voltage matches the rated source voltage.	Compliant 20A=20A The rated load current matches the rated source current.	Installed system is compliant for all parameters. Compliance is not affected by system options or proposed future modules.



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MFG: N Hamidovic	<i>N Hamidovic</i>	20/05/10			
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REVISION 2

**MONDURAN Pty Ltd**

TITLE: **MONEX ENGINE MANAGEMENT CT8, CT10, CT13 ENTITY ANALYSIS**

DWG NO. **12010**

**A3**

FILE **EN\_12010\_Entity analysis\_x**

SCALE:1:1

SHEET 10 OF 11

Reference	Application	Construction	Mechanical protection	Approvals and ratings	Segregation of circuits	Entity parameters		
						Data	Application	
11310 11314	Wiring harness	The wiring harness connects all field sensors (#1250x) to the ECUEx controller (#11328) and has a communication link to the power distribution manager (#11307). The circuits are all certified intrinsically safe. The harness route includes the engine bay where there are elevated ambient conditions and hot engine components. The harness is also routed to the operator control cabin where standard ambient temperature conditions prevail.	(1) XLPE insulated hookup wire that has been individually bundled for each circuit. (2) PVC twisted-pair communications cable (3) Nylon outer sheathing (4) High integrity connectors The hookup wire is 18 AWG (16x30) finned copper with XLPE insulation.	Sensor circuits may contact hot engine components and as such are exposed to elevated temperatures that do not exceed 110 °C. The hookup wire is rated 125 °C. The harness has additional outer nylon braid sheathing with a continuous temperature rating of 120 °C. Heavy gauge metal covers are provided where there exists the potential for mechanical damage. The XLPE wire is intrinsically tolerant of commercial high pressure water cleaners and will resist sustained direct abrasion at point blank range without significant damage.	The hookup wire carries UL approval (600V 125 °C). The nylon outer braid is rated 120 °C. The current rating is nominally 16A at 30 °C	The insulation between active conductors when bundled has a combined thickness that exceeds 1.5mm. This exceeds the minimum requirement of 0.5mm to assure the independence of the circuits.	The parameters for the wiring harness have been conservatively approximated from the #953 datasheet. C - 0.14uF/km L - 0.65mH/km	Per 5m - C - 0.7nF L - 3.25uH Per 10m - C - 1.4nF L - 6.5uH
		The Mbus communication circuit uses a 2 pair x 0.75mm2 twisted pair cable (Unitronic EB CY (TP)) with PVC insulation.	In addition to the above, protection, the communications cable is routed in the operator control cabin, behind the control panel.	The twisted pair UNITRONIC EB CY (TP) complies with the requirements of VDE 0165 section 6.1.3.2.3 - Intrinsic safety. The temperature rating is -40 to +70 °C	The insulation between active conductors has a combined thickness that exceeds 1.0mm. This exceeds the minimum requirement of 0.5mm to assure the independence of the circuits.	The cable parameters are available from the manufacturers datasheet - C - 0.14uF/km L - 0.65mH/km	Per 5m - C - 0.7nF L - 3.25uH	
11329	Multi core cable	The cable provides the Mbus connection between the power distribution module (#11307) and the display module (#11309)	The Mbus communication circuit uses a 2 pair x 0.75mm2 twisted pair cable (Unitronic EB CY (TP)) with PVC insulation.	In addition to the above, protection, the communications cable is routed in the operator control cabin, behind the control panel.	The twisted pair UNITRONIC EB CY (TP) complies with the requirements of VDE 0165 section 6.1.3.2.3 - Intrinsic safety. The temperature rating is -40 to +70 °C	The insulation between active conductors has a combined thickness that exceeds 1.0mm. This exceeds the minimum requirement of 0.5mm to assure the independence of the circuits.	The cable parameters are available from the manufacturers datasheet - C - 0.14uF/km L - 0.65mH/km	Per 5m - C - 0.7nF L - 3.25uH
11323	Multi core cable	The cable connects the sensors (#12502) and piezo valves (#12507) (associated with the pneumatic system) to the power distribution manager (#11307). The circuits are all certified intrinsically safe.	The cable is a factory-terminated multi-core cable comprised of (1) 17 core x 1.0mm2 flexible control cable (2) High integrity connectors (3) Nylon outer sheath	The cable is entirely located in the operator control cabin behind the control panel. The cable is located where there is low risk of mechanical damage.	The multicore cable is 300/500V has flexible PVC insulation and PVC sheathing in accordance with DIN VDE 0281 part 1 and HD 21.1. (PVC self extinguishing and flame retardant to test method B, IEC 60332-1, copper conductors to DIN VDE 0295 class 5 and IEC 60228 class 5, flexing -5 °C to 80 °C, fixed -40 °C to 80 °C)	The insulation between active conductors when bundled has a combined thickness that exceeds 0.6mm to assure the independence of the circuits.	The parameters for the cable harness have been approximated from the #953 datasheet. C - 0.14uF/km L - 0.65mH/km	Per 2m - C - 0.28nF L - 1.3uH Per 2m - C - 0.28nF L - 1.3uH
11324	Multi-core cable	The cable connects the display switches and annunciators (isolated part of #11309) to the power distribution module (#11307) The circuits are all certified intrinsically safe.	(1) 17 core x 1.0mm2 flexible control cable (2) High integrity connectors (3) Nylon outer sheath					
(953)	Multi-core cable	The cable connects the power distribution manager (#11307) to future Mbus nodes eg Methanometers, data loggers, wireless communications	(1) 2 x twisted pair x 0.75mm2 fieldbus cable (2) High integrity connectors (3) Nylon outer sheath The cable will UNITRONIC EB CY (TP) or similar	(Future)	(Future)	(Future)	Based on Unitronic EBCY (TP) cable parameters from the manufacturers datasheet - C - 0.14uF/km L - 0.65mH/km	Per 5m - C - 0.7nF L - 3.25uH
11319	Power cable	The cable connects the power distribution manager (#11307) and the ECUEx controller (#11328) to deliver non-intrinsically safe power. Both terminals to which the cable connects are certified under increased safety.	The cable is Type 2S machine cable under AS1972. 2 core x 1.5mm2	The cable is routed within the structure/chassis of the vehicle.	Machine cable Type 2S under AS1972. Rated current = 23A (The current ratings have been generally calculated in accordance with IEC Publication 287 and are based on an ambient temperature of 40°C).	N/A	N/A	N/A
11320 11322	Power cable	The cable connects the flameproof alternator (3rd party supply) to the power distribution manager (#11307) to deliver non-intrinsically safe power. The terminals on the power distribution module (#11307) to which the cable connects are certified under increased safety.	The cable is Type 2S machine cable under AS1972. 4 core x 1.5mm2	The cable is routed within the structure/chassis of the vehicle.	Machine cable Type 2S under AS1972. Rated current = 23A (The current ratings have been generally calculated in accordance with IEC Publication 287 and are based on an ambient temperature of 40°C).	N/A	N/A	N/A
11301 11302	Injector tails Pump tails	These components have integral cable tails which are inseparable from the solenoids. The cable has been selected for resilience to the engine temperatures and hot engine oil. This excludes traditional machine cables from consideration.	The cable is a two core double insulated screened sheathed silicone cable	The cable is additionally sheathed over its exposed length with closely woven stainless steel braid. The cable is routed within the structure/chassis of the vehicle. Heavy gauge metal covers are also fitted over the portion of the cable route between the controller (#11328) and the engine bay. Additional neoprene heatshrink is used where the injector cable is routed inside the engine tappet covers.	The cable is approved under the certification for the component. The cable also has UL approvals (600V 150 °C).	N/A	N/A	N/A



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REVISION 2

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MATERIAL:

TITLE: MONEX ENGINE MANAGEMENT  
CT8, CT10, CT13  
ENTITY ANALYSIS

DWG NO. 12010

A3

FILE EN\_12010\_Entity analysis\_x

SCALE:1:1

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