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TR for DC/DC converter.

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DC/DC

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VOLVO

Volvo Truck Corporation

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1 Revision History

Revision	Date	Changes
01	2002-10-24	Created by Anders Svensson
02	2002-12-18	Applicable for VTC and RT.
03	2003-01-20	RVI connectors added.
04	2003-06-10	Change severity index to SI 3
05	2003-08-20	Change requirements for reverse polarity and the switched output.

2 RELEVANT DOCUMENTS

ISO/DIS 16750-X (1-6)	Environmental conditions and testing for electrical and electronic equipment
Electromagnetic compatibility	Volvo TR 1579908
MIL-HDBK	217 F
Volvo “black list”	STD 1009,1
Volvo “grey list”	STD 1009,11

3 DESCRIPTION OF PRODUCT

The voltage converter shall be used in trucks to convert 28V DC in to 14V DC. The voltage converter shall be of switching converter type with fixed switching frequency (PWM = pulse width modulation). The voltage converter shall be current limited, short circuit and over voltage protected.

Max. output current: (11±1A / 20±1A) / terminal.
Output terminal(s) together max. 11±1A / 20±1A.

The voltage converter must also have one 14V output terminal switched on/off by none 24V +15-input terminal.

+15 input	**Switched output**
+24V	ON
GND	OFF
Not connected	OFF

The voltage converter must fulfil all legal demands.

4 SUPPLIER'S RESPONSIBILITY

4.1 Life Expectancy

The unit must have a MTBF > 150 000 h with at least 90 % confidence

4.2 Reliability

The supplier shall make a prediction of life expectancy acc. to MIL-HDKB 217, or similar database. The result shall be discussed with Volvo.

A design FMEA at the part level shall be made and documented by the supplier together with VTC. The design FMEA shall include the function of the component, failure mode, failure cause, quantity of failures occurring, and severity of the failures.

When critical process risks are identified in the reliability analysis, a process FMEA shall be made and documented by the supplier. The process FMEA shall include the function of the component. Process stage, failure mode, failure cause, the quantity of failures occurring, severity of the failures, and the failure detectability.

VTC will provide the necessary specifications for the understanding of the function.

4.3 Traceability

The supplier must keep a record on the process test results for each unit, referring to the serial number.

4.4 Function test

Each unit must pass a function test after the assembly. Function test to be approved by VTC.

4.5 Documentation

4.5.1 Material choice

No materials from the “Volvo black list”(STD 1009,1) are to be used neither in the product nor in the production process. Materials from the “Volvo grey list”(STD 1009,11) should be avoided or be used very sparsely.

4.5.2 Change Control

Request for changes in component specification or layout must always be made in advance to VTC.

4.5.3 Test results

All test results must be documented and handed over to Volvo upon conclusion of the test. According to TR-test plan, se section 5.

4.5.4 Drawings

4.5.4.1 Mechanical

The following requirements apply on the drawing:
- Measures showing nominal geometry for installation.
- Minimum three views with dimensions and tolerances according to Volvo std.
- Section view with marked parts, listed in the part list.
- Material to be specified in the part list.
- Specification of connectors (geometrical and material spec.) acc. to VTC-spec.
- Text and logotype marking according to Volvo STD.
- 3D model
- Output on paper, and on one of the following format (IGES, PRO-E, CADDS-5 or Catia).
- Send on E-mail, TIFF-format (black and white with 200dpi resolution)

4.5.4.2 Electrical

- Circuit diagram.
- Component list.
- Printed circuit board layout.
- Printed circuit board assembly, with circuit board number.
- Printed circuit board File.

4.5.5 Other supplier documentation

Design FMEA, Process FMEA, Logistic FMEA, Test plan and TR-test.
Product guarantee with time limits according to commercial agreements.

4.6 Marking

4.6.1 Box (if applicable)

Marked according to STD 5052,41.

4.6.2 External Label

STD 5051,15: MET 4.1-1-HPT-5.2.

Part number, pinout and rated voltage should be included.

4.7 Electrical connection

To the 11±1A pinheader P/N AMP 82 88 01 - 3.
To the 20±1A pinheader P/N AMP 96 61 40 - 3.

Position in pinheader for 11±1A		Position in pinheader for 20±1A	
1:	+24V T(+15 signal)	1:	+14V T(+15 power)
2:	+14V T(+15 power)	2:	+14V T(+15 power)
3:	+14V (+30)	3:	+24V T(+15 signal)
4:	+14V (+30)	4:	+14V (+30)
5:	+14V (+30)	5:	+14V (+30)
6:	GND (12V)	6:	GND (12V)
7:	GND (24V)	7:	+24V (+30)
8:	+24V (+30)	8:	GND (12V)
		9:	GND (12V)
		10:	+24V (+30)
		11:	GND (24V)
		12:	GND(24V)

See 6.1 for connectors for RVI DC/DC converter.

4.8 Mechanical requirements

The protection grade of the box and the connectors must be at least IEC529.
At least IP54 (protect against dust and splashing water).
This will be discussed with the manufacture.

4.9 E-marking

The unit shall be E-marked.

4.10 Surface treatment of printed circuit boards

The PCB must be coated with varnish and the unit shall be protected to pass all testing in section 4 and 5.

4.11 Temperature requirements

Storage temperature: –40°C to +85°C
Operating Temperature: –40°C to +70°C
Maximum skin temperature: @ 65°C ambient temperature < 95°C

4.12 Electrical protection requirements

All the inputs and outputs of the DC/DC-converter must be protected against damage if they are short-circuited to power supply, ground or if they are subject to electrostatic discharges. The unit must also be protected against supply polarity reversal.
In case of a short-circuiting or over load conductors on the PCB carrying supply current must be designed to withstand the current peak.
Internal or external short-circuit must not cause fire.

4.13 Electrical requirements

4.13.1 Supply Voltage

General test conditions
Temperature: 23 ± 5°C
Humidity: 60 ± 25%
Air pressure: 86 to 106 kPa

Rated Voltage	24V DC
Idel current:	< 10mA

Operating voltage according to ISO/DIS 16750-X 16 to 34V DC
With extension for the lower limit to 8V DC.

Overvoltage according to 1579908
A component shall be immune to a high voltage on the supply lines for a certain amount of time. This simulates failure of alternator voltage regulator
(SV-1) and quick charger/starter (SV-2).

Requirements for 24V system.

24V systems			
Test name	**U supply**	**T duration**	**Requirement**
SV-1	36 V	2 hrs	FSC A (class A)
SV-2	48 V	2 min	FSC C (class C)

For pulse immunity see 1579908 chapter 5 Conducted Susceptibility.

4.13.2 Output Voltage

The output voltage: 14 ± 0.7V (when the supply voltage is between 16 and 34V).
Output ripple: < 150mV

In the extended area (supply voltage: 8 – 16V) the output is allowed to exceed the above stated tolerance (class B).
When the supply voltage is 8V the DC/DC converter must deliver at least 1A.

Efficiency: > 90% with full load and over the whole voltage operating range (16 – 34V).

4.13.3 Inputs

Protections against short-circuit and reverse polarity (30V continuous).

4.13.4 Outputs

Protection against short-circuit and system voltage on the outputs.

5 TESTING

5.1 Electromagnetic compatibility test

EMC testing is to be performed according to Volvo TR 1579908 latest issue.

5.1.1 Specific

Severity index: **SI 3**.
Functional status classification: **FCS A**.

5.2 ISO/DIS 16750-X Environmental Conditions and testing for electrical and electronic equipment.

Testing of the unit shall be according to the standards presented below. If there are demands in the TR that does not comply with the ISO standard the demands in the TR are valid. All tests are to be performed as stated in the standard ISO/DIS 16750-X.

5.2.1 ISO/DIS 16750-1 General

Code letter **ISO 16750 – F F F D C Zc X_1 – IP54**
X_1 = TBD.

Operating mode and classification is stated per test in the standard ISO 16750-x.

ISO 16750 1st 2nd 3rd 4th 5th 6th 7th IPxx

1st	16750-2 Electrical loads
2nd	16750-3 Mechanical loads, vibration
3rd	16750-3 Mechanical loads, shock
4th	16750-4 Climatic loads, op. temp
5th	16750-4 Climatic loads
6th	16750-5 Chemical loads
7th	16750-6 System integration (TBD)
IPxx	DIN 40050-9

5.2.2 ISO/DIS 16750-2 Electrical loads

Supply Voltage according to Item 4. For 24V Code F with extension for the upper limit to 34V and with extension for the lower limit to 8V, with reduced function (class B) between 8 - 16V.
For Item and 4.2.2.2 the requirement shall be class B.
For Item 4.4.2 the requirement shall be class C.
For Item 4.5.3.2.2 the requirement shall be class C.

5.2.3 ISO/DIS 16750-3 Mechanical loads

Test According to mounting location, code letters F (in table 17).
For test 4.2.1 the following data is valid.

Duration:	11ms
Shock form:	Half sine
Direction:	±X, ±Y, ±Z
No of shocks in each direction:	3 (total 18)
Requirement:	Class A

5.2.4 ISO/DIS 16750-4 Climatic loads

Operating Temperature range according to table 1, code D (–40°C to +70°C).
Code for climatic loads according to table 4, code C.
The same temperature range is used for climatic load (Temperature cyclic, Temperature shock, Humid heat cyclic and Damp heat).

5.2.5 ISO/DIS 16750-5 Chemical loads

Chemical loads according to Annex A, Zc as C, except battery fluid, hydraulic fluid and Kerosene.

6 APPENDIX

6.1 Electrical connection RVI

To the 11±1A pinheader P/N FCI RT94BR08WH*T.
To the 15±1A pinheader P/N AMP 82 88 01 - 4.

Position in pinheader for 11±1A		Position in pinheader for 15±1A	
1:	+BAT (24V)	1:	-BAT (0V)
2:	- BAT (0V)	2:	+BAT (24V)
3:	+14V	3:	+Acc (24V)
4:	GND (12V)	4:	+14V
5:	+14V	5:	GND (12V)
6:	GND (12V)	6:	+14V
7:	NC	7:	GND (12V)
8:	NC	8:	GND (12V)
		9:	+14V (Acc)
		10:	+14V (Acc)
		11:	+14V (Acc)

6.2 Test sequence