

DUAL CAR-FANS CONTROL 40 A RELAY BOX (PN 1379131-1)

MODIFICATION INVENTORY		
INDEX	Date	Description
O	SEPTEMBER 2001	CREATION
A	DECEMBER 2002	Clarification of Degree of protection requirement 3.4.7 Definition of the dielectric test 3.4.12 Definition of vibration and durability test. Clarification of all the specification 108-15257.
		(*) § 3.1.2 and § 3.1.3 p 6/16 Products delivered to Valeo must the resistor value of the relay box specified in Tyco specification 108-15257 Rev A. However, Valeo would like to review these datas with Tyco in order to full agree on a common approach to set upper and lower limits. <i>[Signature]</i> 9.12.02

TYCO ELECTRONICS Date : 9 DEC 02 Approved by JOSÉ FERREIRA Signature <i>[Signature]</i>	Customer: VALEO Date : 9.12.02 Approved by Nicolas MARSHO Signature <i>[Signature]</i>
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1 SCOPE

1.1 CONTENT

This document covers the performances, tests, and quality requirements of the "ENGINE COOLING RELAY BOX". It describes the tests that are performed by Tyco Electronics. Some other tests performed by VALEO are described in 02013_Fan System Test Spec Rev B.

In the event of any deviation from the TYCO specification number 108-15257 Tyco will inform VALEO.

Depending on the criticality, a written approval will be proceeded or TYCO would have to solve the problem.

1.2 LIST OF ABBREVIATIONS

LS	Low speed
HS	High speed
ECU	Electronic Control Unit
Us	Supply voltage of ECU

2 REFERENCE DOCUMENTS

2.1 ORDER OF PRECEDENCE

In the event of a conflict between the text of the specification 108-15257 and the documents cited herein, the text of the specification 108-15257 takes precedence.

For the relays of the relay box, the TYCO specification V23076-A1001-C133, V23076-A3001-C132, V23076-A3034-X01 takes precedence.

For the electrical wire of the relay box, the SAAB specification STD 5053 SAAB takes precedence.

For the 2 ways connector, the TYCO specification 108-15317 takes precedence.

Nothing in the procedures, however, supersede applicable laws and regulations unless a specific exemption has been obtained.

Valeo and Tyco acknowledges that to the best of their knowledges, there is no conflict between specification 108-15257 and the documents cited herein. Any way, Tyco and Valeo will inform the other party if any conflict occurs.

2.2 IEC SERIES

60 068 Basic testing and measuring methods.

60 512 Electromechanical components for electronic equipment – Basic testing and measuring methods.

DIN 40050 Part 9 Protection provided by enclosures (IP codes)

2.3 VALEO SPECIFICATIONS

SPEED CONTROL UNIT & WIRE HARNESS FOR AN ENGINE COOLING FAN (Ind E, dated 10/00).

2.4 GM SPECIFICATION

GME 12513: Electrical fans for engine cooling
GMI 12556: General specification for electrical/electronic subsystem and components.
GMI 12557: General specification for electrical subsystem and components.
GMI 12558: General specification for electrical subsystem and components.
GMI 12590: Electrical connectors.
GME 60 211: Salt spray fog testing for Electrical/Electronic components.
GME 60202 : Testing to High Humidity Environment
GME 60206 : Salt Spray Fog Testing
GME 60261 : Determining the Flammability of Interior Trim Materials
VDA 260 : Parts of motor vehicle – Marking of materials
GMW 3059 : Material specification general

2.5 OTHER SPECIFICATIONS

ISO 11451-1: 1995. Road vehicles- Electrical disturbances by narrow radiated electromagnetic energy- Vehicle test method. Part 1 General and definition.

2.6 QUALIFICATION

When tests are performed on subject product & subjects product lines, procedures specified in IEC 60512 series specifications shall be used. All inspections shall be performed using applicable inspection plans and products drawings.

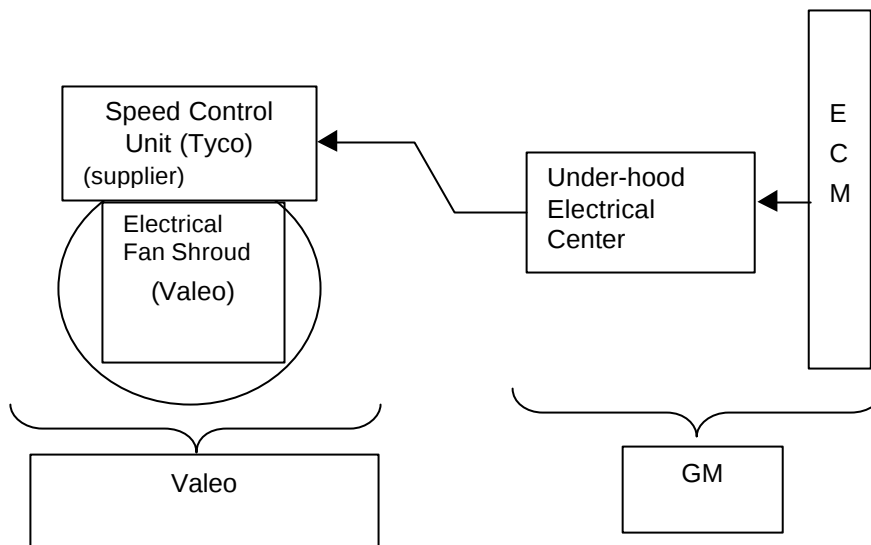
3 PRODUCT FUNCTIONALITIES AND TEST REQUIREMENTS

3.1 PRODUCT FUNCTIONALITIES

3.1.1 SUBSYSTEM DEFINITION

The speed control unit allows a dual fan system to be multi stage with four speeds. The fan system is associated with one or more cooling exchangers called the engine-cooling module, in order to cool the car engine. The engine module is placed in the car under-hood in the front end. The multistage speed is intended to optimize the cooling and climate management.

The speed control unit will be managed by the car Electronic Control Module via the Under-hood Electrical Center with discrete input signals.



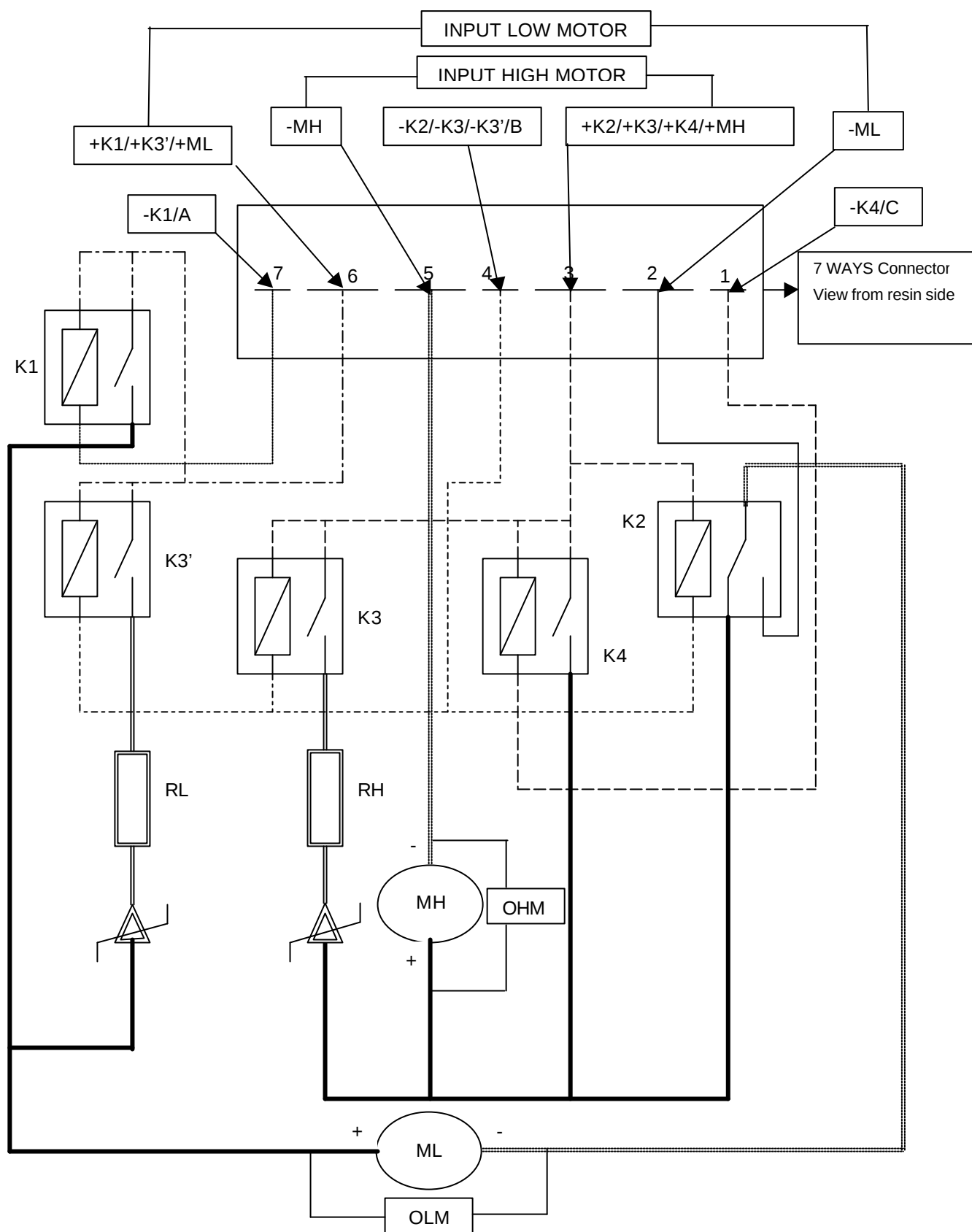
3.1.2 SPEED DEFINITION LOW MOTOR.

A	B	C	Step	Low Motor Speed ratio Mini / Maxi (Reference only)	Resistance of the output Load Low motor (LLM) Mini / Maxi (mohm)	Resistor Value of the relay box for each speed for Low Motor Mini / Maxi (mOhm)
0	0	0	Off	0% of HS	-	-
1	0	0	LS1 = Low Speed 1	Motor in series	1000/1500	0/80
0	1	0	LS2 = Low Speed 2	73% / 77% of HS	500/1000	400/650
1	1	0	LS3 = Low Speed 3	100% of HS	500/1000	0/80
1	1	1	HS = High Speed	100% of HS	500/1000	0/80

3.1.3 SPEED DEFINITION HIGH MOTOR.

A	B	C	Step	High Motor Speed ratio Mini / Maxi (Reference only)	Resistance of the output Load High motor (LHM) Mini / Maxi (mohm)	Resistor Value of the relay box for each speed for High Motor Mini / Maxi (mOhm)
0	0	0	Off	0% of HS	- / -	-
1	0	0	LS1 = Low Speed 1	Motor in series	1000/1500	0/80
0	1	0	LS2 = Low Speed 2	71% / 75% of HS	300/600	340/475
1	1	0	LS3 = Low Speed 3	71% / 75% of HS	300/600	340/475
1	1	1	HS = High Speed	100% of HS	300/600	0/60

3.2 ELECTRICAL CIRCUIT



3.3 TEST REQUIREMENTS

The tests are carried out following the test schedule Paragraph 3.6. Number of components to be tested is defined in this test schedule.

Electrical connection. All electrical functional tests shall be performed with the component electrically connected as in the vehicle. All inputs of electrical/electronic components shall be supplied with the specified signals. All outputs shall be loaded to enable simulated vehicle operation of the component.

Test Voltage. Unless otherwise specified, tests shall be performed at nominal supply voltage U_s at the Relay Box connection..

Test Voltage : $U_s = 12.7 \text{ V} \pm 0.2 \text{ V}$. Measured at relay box connection.

Ambient temperature. Unless otherwise specified, tests shall be performed at nominal room temperature T_a .

Ambient temperature : $T_a = 23^\circ\text{C} \pm 5^\circ\text{C}$.

3.3.1 INITIAL TEST

The electrical motor curve should be available from VALEO, and the fan should be balanced to a value to be defined.

VISUAL INSPECTION:

The relay box shall have no visible default or damage on the equipment that may or may not disturb one or more function or appearance of the equipment. The box, and fan system should have a proper identification. Check that right box is mounted on the right shroud, with the right fan, fan engine, and right exchanger module.

The Speed control unit shall meet the dimension and tolerances specified on the drawing

CURRENT CONSUMPTION:

After a warm-up running time of 2 minutes at highest speed, the current of each fan must be measured for all speeds, when the fan system is mounted on a representative heat exchanger module. This test is made according to GME 12513 paragraph 7.2

The value must not exceed 21A for the motor high in high speed and 14A for the motor low in high speed.

The relay current (signal 1, 4, 7) shall be measured at 16V at the relay box connection and the values of the current consumption must not exceed 250mA for track n°1; 500mA for track n°4 and 250mA for track n°7.

3.4 FUNCTIONAL TEST

3.4.1 RESISTANCE MEASUREMENT

A Voltage of 12.7V is applied between the track 3 and 5 of the 7 ways connector for the high motor and between the track 2 and 6 of the 7 ways connector for the Low Motor. The 2 connectors 2 ways of the relay box are connected to the motors or to equivalent resistance (for the values of the resistor see tables § 3.1.2 and 3.1.3). The output voltage is measured on the 2 ways connector according to the tables paragraph 3.1.2 for the Low Motor and paragraph 3.1.3 for the High Motor

The value measured must be in the tolerance of these tables.

3.4.2 OPERATING VOLTAGE RANGE

The status of function is classified according to GMI 12556 General specification for electrical/electronic subsystem and components.

Class A: all functions of a device/system perform as designed during and after exposure disturbance.

Class B: all functions of a device/system perform as designed during exposure, however, one or more of them can go beyond specified tolerance. All functions return automatically to within normal limits after exposure is removed. Memory functions must remain class A.

Class C: all functions of a device/system does not perform as designed during exposure, but returns automatically to normal operation after exposure is removed.

The box has to meet the functional status classification, class A or class C, regarding to the supply voltage range.

Under and low voltage ($0V \leq U_s < 10V$): Functional status classification C.

Normal voltage ($10V \leq U_s < 16V$): Functional status classification A.

3.4.3 REVERSE POLARITY VOLTAGE PROTECTION

The box is protected against a reverse polarity supply voltage of 13V DC for 60s for each speed according to GMI 12557 R paragraph 4.4. This requirement ensures immunity to misconnect batteries when the reverse voltage occurs on all supply lines simultaneously.

The functional status classification of the box during exposure to reverse polarity must be class C. After exposure to reverse polarity supply voltage the component must meet the requirements of functional state A.

3.4.4 OVER VOLTAGE PROTECTION

The box has to meet the functional status classification class B or class C, regarding to the supply voltage range.

The test shall be done at "Us" V on each speed (with a different motor) and the thermo fuses must not fuse.

Over voltage test ($U_s = 26V$, 1min for each speed): Functional status classification C according to GMI 12557 R paragraph 4.2

3.4.5 STALL CURRENT

- 12V is applied at the wiring harness of the vehicle with the fuse box.
- The relay box is mounted in the fan system with the exchanger module as in the vehicle.

3.4.5.1 Low fan speed control by resistor.

Must be secure with thermo fuse. Fuse must withstand initial starting current peak in all conditions.

Test conditions: - 12V is applied at the wiring harness of the vehicle with the fuse box.

- The relay box is mounted in the fan system with the exchanger module as in the vehicle. The whole system is tested inside an oven.
- The chamber of the oven have a volume of 1m³
- Ambient temperature 80°C and –10°C
- Fan stalled

Procedure:

Apply voltage to stalled system, measure $I=f(t)$ through fans. Conduct test until thermo fuse blows off.

Requirements:

During and after the test, no degradation or damage (fusion, deformation, fire ignition, etc) of test sample (including fan motor) or surrounding plastic part (as shroud) shall occur. No smoke or toxic gases shall be emitted. After the test, the fan must work properly at its maximum speed once the rotor has been released. The part containing the resistor and the thermo fuse must be detachable from the module without damages or difficulties, in order to be replaceable.

3.4.5.2 Protection in normal fan system use.

Under normal fan system use (fan not blocked), at 16V at the wiring harness (battery level) check that no protection is activated after 5 minutes for all speed stages at 80°C.

Test conditions:- 16V is applied at the wiring harness of the vehicle with the fuse box.

- The relay box is mounted in the fan system with the exchanger module as in the vehicle. The whole system is tested inside an oven.
- The chamber of the oven have a volume of 1m³
- Ambient temperature 80°C.

3.4.6 SALT SPRAY

The salt spray test is to be performed according to GME 60211 Specification unless otherwise stated. This test is a functional test and not a surface protection test.

The relay box is mounted in the fan system with the exchanger module as in the vehicle. Test shall be performed with the components electrically connected as in the vehicle with all connectors, cables and power supply and mounted in the vehicle position.

3.4.6.1 Cycle

24h Storage in salt spray fog to GME 60206

6h Drying period at +40°C ±3 K

18h Storage in salt spray fog to GME 60206

6h Drying period at +40°C ±3 K

18h Storage in salt spray fog to GME 60206

6h Drying period at +40°C ±3 K

24h Storage in salt spray fog to GME 60206

66h Drying period at +40°C ±3 K

The test is performed during two weeks (two cycles).

The functional status mode of the box shall remain class A during those cycles.

Electrical load on the box during the test exposure.

During the storage in the salt spray, ignition on condition is applied on the system. During this phase, the component shall be functionally switched on as per table bellow.

The box shall be set to the condition corresponding to the vehicle "ignition off" during the drying period: No voltage applied on the box

Speed																								
HS						X						X					X		X					
LS3					X	X	X					X					X		X	X				
LS2				X	X	X	X	X				X	X	X			X		X	X	X			
LS1	X		X	X	X	X	X	X	X		X	X	X	X	X		X	X		X	X	X	X	
0	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Time	1 min	1 min	2 min	2 min	2 min	10 min	2 min	2 min	5 min	1 min	3 min	2 min	4 min	2 min	3 min	1 min	4 min	15 min	1 min	2 min	2 min	2 min	3 min	1 min
Nbr of cycles	a : 50 cycles		b : 4 cycles									c : 4 cycles						d : 1 cycle		e : 1 cycle				

At the end of each drying period, before to restart the salt spray period, the component shall be switched on as defined above and functionally tested for each speed during 10 minutes.

3.4.7 DEGREE OF PROTECTION (IP CODE)

The degree of protection is :

IP24KCM on the relay box mounted on the complete heat exchanger module of VALEO

For the 2 ways connector see the specification 108-15317

The test of degree of protection (IP code) shall be carried out following DIN 40050 part 9

Test duration: 10 minutes.

The box is on an exchanger, and connected with the appropriate cables and connectors.

During testing, the fan is periodically switched on for around 30s and switched off for around 30s.

After 48h drying at room temperature no function defects shall be apparent.

After the test the fan system shall show data according to clause 3.4.11 Short Function Test

3.4.8 STORAGE

Four boxes are stored for 8h (± 0.5 h) at -40°C ($\pm 3\text{K}$). Then two boxes are stored in a high humidity constant climate (# 100%) according to GME 60 202-D1 during 48h at $40^{\circ}\text{C} \pm 3\text{K}$, and the remaining boxes are stored for 16h (± 0.5 h) at 110°C ($\pm 3\text{C}$) in their installation position. This test is made according to GME 12513 paragraph 7.6

After this storage, the requirements of functional status A shall be met.

3.4.9 THERMAL SHOCK TEST

The test will be performed with the component electrically connected as in the vehicle, no voltage on the connector (parked mode). The test is made according to GMI 12558 paragraph 6.2.5

The test is made according to IEC 60068-2-14 Test Na.

Low temperature during 1h: $-40^{\circ}\text{C} + 3^{\circ}\text{C}$.

High temperature during 1h: $110^{\circ}\text{C} \pm 3^{\circ}\text{C}$.

Number of cycle: 60, with 20s maximum of temperature change.

The requirement of functional status class A shall be met after the test.

3.4.10 DURABILITY TEST

This test is applicable to the dual fan with 4 speeds in a puller position. This test must be made by VALEO except if TYCO decide to change the design of the relay box after the VALEO qualification.

Description of test

Test voltage: 12.7 Volts

[illegible]

During the cycle A : The ambient temperature is 80°C

During the cycle B : The ambient temperature is 80°C all along the cycles with the exception of every 196h the temperature is raised up to 90°C during 2 hours followed by 110°C during 1 hour and then back to 80°C.

Cycle definition									
	A (1 cycle)	B (370 cycles)						Global (heure)	Global (%)
		a (min)	b (min)	c (min)	d (min)	e (min)	Total B (min)	Ax1+Bx370	%
OFF	1	50	4	4	1	1	60	370,0	20,0
LS1	0	50	28	24	4	3	109	672,2	37,0
LS2	0	0	16	16	0	2	34	209,7	12,0
LS3	0	0	16	0	0	2	18	111,0	6,0
HS	480	0	40	16	15	2	73	458,2	25,0
Total	481	100	104	60	20	10	294	1821	100

After “A cycle” a resistance measurement is performed as the reference. The short function test after this durability test shall be compared to this reference.

The functional status mode of the box shall remain class A during and after those cycles.

3.4.11 SHORT FUNCTION TEST

A Voltage of 12.7 V is applied between the track 3 and 5 of the 7 ways connector for the high motor and between the track 2 and 6 of the 7 ways connector for the Low Motor. The 2 connectors 2 ways of the relay box are connected to the motors or to equivalent resistance (for the values of the resistor see tables § 3.1.2 and 3.1.3). The output voltage is measured on the 2 connectors 2 ways connector.

The values measured must be in the tolerance of the tables paragraph 3.1.2 for the Low Motor and paragraph 3.1.3 for the High Motor

3.4.12 DIELECTRIC WITHSTANDING

A voltage $U_{RMS} = 500V$ AC with $f = 50$ Hz is applied between each track of the lead frame during 4 second.

During this test only the lead frame is tested in the relay box housing (no relay, no resistor, no thermo fuses, no harness, no resin are assembled). Because it is impossible to test the insulation resistance of all the tracks of the lead frame if the components are soldered onto the lead frame.

The requirement is no breakdown or flash over within 4s. This test is made according to GME 12513 paragraph 7.12

3.5 MECHANICAL STRENGTH

3.5.1 CONNECTOR 7 WAYS

3.5.1.1 Contact retention.

The test will be performed with the complete box on all the contact.

The test is made according to IEC 60 512 test 15a

The minimum effort required for the retention of this kind of contact is 60 N.

After the drop test, all the contact must have a retention effort of 60N minimum.

3.5.2 CONNECTOR 2 WAYS

See specifications TYCO 108-15317

3.5.3 HARNESS TRACTION TEST

The test will be performed on the complete box. The harness shall meet the STD5053 SAAB electrical wire.

We apply a load of 10 kg during 5 minutes on the harness and After the test the harness must not have been disconnected, and the product must be functional.

3.5.4 VIBRATION RESISTANCE

The test shall be performed on the complete cooling module (fan + heat exchanger) with its representative fixing point. The vibration cycle shall be representative to the vibration on car.

This test must be made by VALEO except if TYCO decide to change the design of the relay box after the VALEO qualification.

Test procedure

The test should be done in each axis (x, y, z) during 30h

This signal vibration are defined in the table in the appendix 6.1

After the test:

no defect which could affect the strength, function or appearance of the fan system shall be apparent.

the relay box shall show data according to clause 3.4.11.

3.6 TEST SCHEDULE.

Test			Test order - fan system N°																				result		Report	Comment
	Test spec	Qty	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	C	NC		
Initial test (resistance measure)	§ 3.4.1	19	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1					1 day
Thermal shock test	§ 3.4.9	1	2																							5 days
Storage	§ 3.4.8	4		2	2	2	2																			5 days
durability test	§ 3.4.10	5		3	3	3	3	2																		76 days
Vibration resistance 80oC	§ 3.5.4	1							2																	5 days
Salt spray test functional	§ 3.4.6	1								2																15 days
protection type IPX4K	§ 3.4.7	1									2															3 days
motor stall LS2 High -10oC	§ 3.4.5.1	1										2														1 day
motor stall LS2 Low -10oC	§ 3.4.5.1	1											2													1 day
motor stall LS3 High -10oC	§ 3.4.5.1	1												2												1 day
motor stall LS2 High 80oC	§ 3.4.5.1	1													2											1 day
motor stall LS2 Low 80oC	§ 3.4.5.1	1														2										1 day
motor stall LS3 High 80o	§ 3.4.5.1	1															2									1 day
motor stall LS2 +80oC 16V	§ 3.4.5.2	1																2								1 day
motor stall LS3 +80oC 16V	§ 3.4.5.2	1																3								1 day
Operating Voltage range	§ 3.4.2	1																	2							1 day
Reverse polarity protection	§ 3.4.3	1																	3							1 day
Over voltage protection	§ 3.4.4	1																	4							1 day
Mechanical strength / Contact retention	§ 3.5.1	1																		2						1 day
Mechanical strength / Harness traction test	§ 3.5.2	1																			2					1 day
Electrical strength	§ 3.4.12	1																				1				1 day
short function test	§ 3.4.11	10	3	4	4	4	4	3	3	3	3							4	5							1 day
																										TOTAL days
			6	83	83	83	83	78	7	7	5	1	1	1	1	1	1	1	1	1	1	1				444

4 PRODUCT DESCRIPTION

4.1 COMPONENTS

The physical content of the speed control unit is the following :

- Relays or other similar components which have the same function
- Electrical coil resistor with thermal protection or other similar components which have the same function,
- Wires and protection shields or other similar components which have the same function,
- Connectors or other similar components which have the same function,
- Resin or other similar components to protect the box
- Other components if needed to complete the function

5 CAVEAT

5.1 THERMO FUSES / STALL PROTECTION

On the product, ONLY the LS2 and LS3 speeds, which use the box coil resistors, are protected by the thermo-fuses, as per test requirements of §.3.4.5

The overall car protection is to be warranted by the car fuses.

No protection is warranted :

- if any products external of the epsilon relay box are in contact with the coil resistors, and which could generate fumes or fire.
- If the geometry of the box is modified in any way (e.g. due to a crash or to makeshift).

5.2 EMC

Cannot be tested out of the full car assy. Tyco Electronics does not warranty any EMC level.

6 APPENDIX

6.1 VIBRATION SIGNAL

Axe X		Axe Y		Axe Z	
Freq. (Hz)	Dsp(g ² /Hz)	Freq. (Hz)	Dsp(g ² /Hz)	Freq. (Hz)	Dsp(g ² /Hz)
3	0.0004	3	0.0048	3	0.0149
3.5	0.0005	3.5	0.0060	3.5	0.0173
4	0.0004	4.5	0.0017	4	0.0113
5.5	0.0007	5.5	0.0024	7	0.0060
6.5	0.0005	6	0.0024	11	0.0513
7	0.0005	7	0.0014	11.5	0.0471
9	0.0020	7.5	0.0013	13	0.0242
11.5	0.0228	13	0.0560	14.5	0.0294
13.5	0.0406	13.5	0.0655	15.5	0.0275
14	0.0421	14	0.0623	16.5	0.382
15.5	0.0331	15	0.0457	17	0.0370
17	0.0306	15.5	0.0471	18.5	0.0156
19	0.0104	16.5	0.0758	22.5	0.0037
21.5	0.0068	17	0.0714	24	0.0027
23.5	0.0053	19.5	0.0132	29.5	0.0026
30.5	0.0094	20.5	0.0117	30.5	0.0027
33	0.0150	23	0.0142	38	0.0074
34.5	0.0167	24.5	0.201	42	0.0099
41.5	0.0179	25.5	0.0216	44	0.0094
42.5	0.0167	28	0.0164	50	0.0048
46.5	0.0090	30	0.0172		
50	0.0079	33	0.0339		
		34	0.0386		
		35	0.0369		
		37	0.0369		
		40	0.0211		
		50	0.0074		