



Electrical Requirement Specification - Gear Shift Lever for AMT

TATA Motors

PROJECT: AMT for Osprey

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TITLE: AMT for Osprey – Electrical Requirement Specification - Gear Shift Lever for AMT

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Prepared : Anupama Gore

Checked:

Approved: Vilasini Prabhu

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Change History

Issue	Page	Section	Change details
0.1	ALL	ALL	New release for discussion with supplier (Section 7.1, 7.2, 7.6 modified for sport button removal. Section 7.4.1 (note3) added
0.2	Page 18,19	Section 7.6, 7.7	Section 7.6, illumination connector table deleted. Section 7.7.3, illumination details deleted.
0.3	Page 16	Section 7.4, 7.5	Section 7.4 updated for diagnostic zones Section 7.5 Hardware details (TCU Type 2, Non TML PT) removed. Section 8 to 14 are removed.
0.4	Page 13, 14,15	Section 7.4.2,7.4.3, 7.4.5, 7.3.2	7.4.2- updated 7.4.3 - updated 7.4.5 -updated 7.3.2 –added table

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18.	Tool Requirements (TBD)	Error! Bookmark not defined.
19.	Testing Support (TBD)	Error! Bookmark not defined.
20.	Documentation Requirements (TBD)	Error! Bookmark not defined.

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1 Introduction

1.1 Overview & Purpose

The purpose of this document is to develop a gear shift lever that will allow the driver to select the appropriate gear. This gear shift lever will be incorporated in a vehicle with automated manual transmission

The gear shift lever unit will read input from the sensors mounted on the lever and will send the processed output to the transmission control unit

1.2 Document Scope

This document is a requirement specification of the Gear Shift Lever Unit that will be an integral part of the Automated Manual Transmission system to be introduced in Tata Motors' passenger car projects. **This document is specifically meant for the AMT project with TCU from Magneti Marelli.** This document specifies the functionality and the constraints which should govern the development of the GSL module. The Transmission domain owners, the concerned CoCs in E&E, TML Test departments (IDT, ODT) and the GSL Module manufacturers are the intended participants and audience of this specification. **All future use and/or duplication of this specification document must be approved by CoC – PT.**

1.3 Terminologies

Term / Abbreviation	Description
TML	TATA Motors Limited
ECU	Electronic Control Unit
EMI	Electro Magnetic Interference
EMC	Electro Magnetic Compatibility
TCU	Transmission Control Unit
ADC	Analog to Digital Converter
GSL	Gear Shift Lever
TBD	To Be Defined

1.4 Approval Authority of the document

Any modifications to this document must be approved by Ms. Vilasini Prabhu (ERC.E&E.CoC-PT) & Mr. Makarand Ponshe (ERC- Transmission).

1.5 Change Control Process of the document

Once this document is released after final discussions with the supplier, all further changes should occur in response to an Engineering Change Request (ECR) and all new versions of this document must go through the formal approval process before they are released.

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2 Reference Documents

2.1 Order of Precedence

Resolution of Conflicts within this Document:

In the event of a conflict between the text of this requirements specification and one of the referenced documents called by this document, the text of this specification takes precedence. However, in the event of a conflict between this document and applicable laws and regulations, the laws and regulations take precedence.

2.2 TML Documents

The intended audience is requested to refer to the latest versions of the following documents.

Document	Doc Ref No	Version No
Environmental requirements for Electrical and Electronic Components subassemblies	TST_TS_WI_233	3
Compliance sheet for Environmental requirements for Electrical and Electronic Components/sub assemblies	----	---
EMC requirements for Electrical and Electronic Components, sub assemblies	TST_TS_WI_257	3
Compliance Sheet for EMC requirements for Electrical and Electronic Components/sub assemblies	----	---

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3 Application Matrix

This sensor will be used for multiple transmissions, which are meant for different vehicles as indicated in table below,

Sr	Vehicle	Engine/EMS Supplier	Transmission		Note
1	Osprey	Diesel/ Delphi Petrol /	TA6300		TML Powertrain

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4 Environmental Requirements

The supplier shall provide Gap Analysis against TML specification, for DVP.

TML Environmental test requirements (refer paragraph1, below) are applicable to all Electrical and Electronic components/sub assemblies (including Electronic Control Units, actuators, relays, motors etc). Suppliers are requested to follow the following TML specification for Environmental validation for their products.

1. TATA Environmental Specification No. TST/TS/WI/233, Revision –3. This is a generic document and designed to give guidelines to decide correct test parameters for Environmental testing. The following international standards are linked in the TML requirements. E.g. ISO and SAE.

1.1. TML will share a specific Environmental test compliance matrix in the controlled excel format, which is fully linked with TST/TS/WI/233, Rev-3. Supplier has to fill the last two columns in the excel sheet to accept the requirement or specific justification for deviation, if any for each tests.

Note: Supplier has to refer specific TML specification for the details of test parameters and acceptance criteria of each test. Supplier shall ensure from concern TML engineer that he has been shared correct and latest version of the above specification.

If supplier is agreed with TML requirements, the 'Agreed Environmental compliance Matrix' will be signed off by concerned TML authority, which will become a part of signed DVP.

In case Component supplier does not meet any specific Environmental requirements due to hardware and software limitations of the Component or Component functional application requirements, supplier shall discuss all such issues with TML for approval before finalization of 'Agreed Environmental compliance Matrix'. No deviation will be allowed with respect to 'Agreed Environmental compliance Matrix'.

During product development cycle, supplier shall maintain, 'Development statues matrix', to update the Environmental developmental statues of components to TML.

Supplier shall prepare a deviation document, against 'Agreed Environmental compliance Matrix'.

If any major deviation is observed and based on its risk factor, TML will take appropriate decision, for improvement at supplier level.

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5 EMI/EMC Requirements

The supplier shall provide Gap Analysis against TML specification, for DVP.

The TML EMC test requirements (refer paragraph1, below) are applicable to all Electronic controlled Units (ECU's), Electrical actuators and motors. Suppliers are asked to follow the following TML specification for EMC validation for their products.

1. TATA EMC specification No. TST/TS/WI/257, Revision-3 for 12 volt system. This is a generic document and designed to give guidelines to decide correct test parameters for EMC testing. The following international standards are linked in the TML requirements. E.g. ISO, CISPR and SAE.

1.1. The TML will share a specific EMC test requirements in the controlled excel format, which is fully linked with TST/TS/WI/257, Rev-3. Supplier has to fill the last two columns in the excel sheet to accept the requirement or specific justification for deviation, if any for each tests. Supplier is responsible for the functional group classification (Examples refer to Annexure -1 of TST/TS/WI/257, Rev-3) for all the functions supported by their respective components. This has to be approved by concerned TML domain engineer.

Note-1: Supplier has to refer specific TML specification (12Volts system or 24Volts system) for the details of test parameters and acceptance criteria of each test. Supplier shall ensure from concern TML engineer that he has been shared correct and latest version of the above specification.

Note-2: Insert table for Functions and group classification. Also specify the required Region of performance, if different from EMC requirement specification.

If supplier is agreed with TML requirements, the 'Agreed EMC compliance Matrix' will be signed off by concerned TML authority, which will become a part of signed DVP.

In case Component supplier does not meet any specific EMC requirement due to hardware and software limitations of the Component or Component functional application requirements, supplier shall discuss all such issues with TML for approval before finalization of 'Agreed EMC compliance Matrix'. No deviation will be allowed with respect to 'Agreed EMC compliance Matrix'.

During product development cycle, supplier shall maintain, 'Development statues matrix', to update the EMC developmental statues of components to TML.

Supplier shall prepare a deviation document, against 'Agreed EMC compliance Matrix'.

If any major deviation is observed and based on its risk factor, TML will take appropriate decision, for improvement at supplier level.

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6 Wiring Harness Guidelines

Supplier shall inform specific requirements / impact on wiring harness specifications, like

- a. Requirements of Shielded wires/ Twisted wires along with wire type and pitch
- b. Requirements of special routing of wiring harness
- c. Vicinity to high Voltage devices
- d. Power and Fusing Strategy
- e. Special Grounding requirements
- f. Special EMI/EMC precautions
- g. Mounting area / orientation restrictions if any
- h. Mounting area restrictions for Vibration and water ingress etc
- i. Length, wire size and resistance of the cables used in wiring harness
- j. Overall milli-volt drop/ resistance/ impedance requirements of wiring harness
- k. Requirement of additional Protection from water, temperature, abrasion, sharp edge, vibration, etc eg. corrugated tube, special tube, cover, no protection etc)
- l. Wiring harness Clamping requirements
- m. Requirements of use of rubber grommets (boots) or covers on the component

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7 Function Description

This section describes the electrical working principle behind the gear shift lever which together with the automated manual transmission facilitates the driver to select the desired gear.

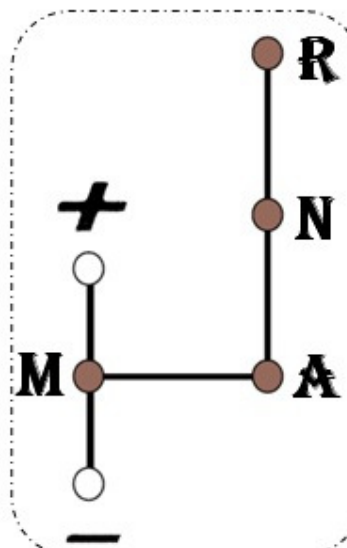
7.1 GSL Positions

The electronics of the gear shift lever should have the following features:

- Should be able to detect the positions
 - M (Manual mode)
 - N (Neutral)
 - + (next higher gear during manual gear change)
 - – (next lower gear during manual gear change)
 - A (Automatic mode)
 - R (Reverse Gear)
- Should contain 4 Hall Effect sensors and a magnetic field plate to detect the above positions.

7.2 GSL Shift Pattern

Brown: stable position
White: unstable position



Note¹:

1. The shifting range tolerance for each of the positions in the above diagram shall be defined by the GSL unit supplier and approved by the concerned teams in TML i.e. ERC – Transmissions and E&E – CoC Powertrain

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7.3 Logic table

7.3.1 Output from GSL module unit to TCU (without pull up)

Description	Signal Lines				Remarks
	A1	A2	A3	A4	
A	1	0	0	1	
M	0	0	0	0	
+	1	1	0	0	
-	1	0	1	0	
N	0	0	1	1	
R	0	1	1	0	

7.3.2 Output from GSL module unit to TCU (with pull up)

Description	Signal Lines				Remarks
	A1	A2	A3	A4	
A	0	1	1	0	
M	1	1	1	1	
+	0	0	1	1	
-	0	1	0	1	
N	1	1	0	0	
R	1	0	0	1	

7.3.3 Fault Detection

The GSL unit should be able to output different voltage ranges (Refer sec **Error! Reference source not found.**) of output signals (A1...A4) in case of electrical faults to enable diagnosis for each fault listed below.

- Battery pin disconnected
- Ground pin disconnected
- Any Data line (Ax) open circuit
- Any Data line (Ax) short circuit to battery
- Any Data line (Ax) short circuit to ground
- Any two Data lines (Ax) short among themselves

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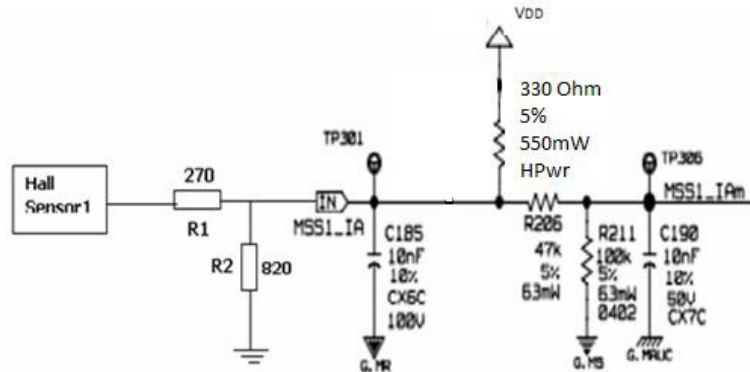
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7.4 Hardware details (TCU Type 1, TML PT)

7.4.1 Circuit Schematic Option-1 (TCU type-1, TML PT)



7.4.2 GSL module output - logical voltage levels with pull up

Description	Min	Nom	Max	Unit	Remarks
State 0	1.5	1.88	2.25	V	Note 1
State 1	3.2	3.65	4.1	V	

Note:

1. The values are with supply of 5V. TCU (for TML Powertrain) supply of 5V is available for the series.
2. The above values may be different for non-TML Powertrain.
3. Pull up in TCU (R196 & R201 are 660 Ohm, so effective) is 330 ohms.

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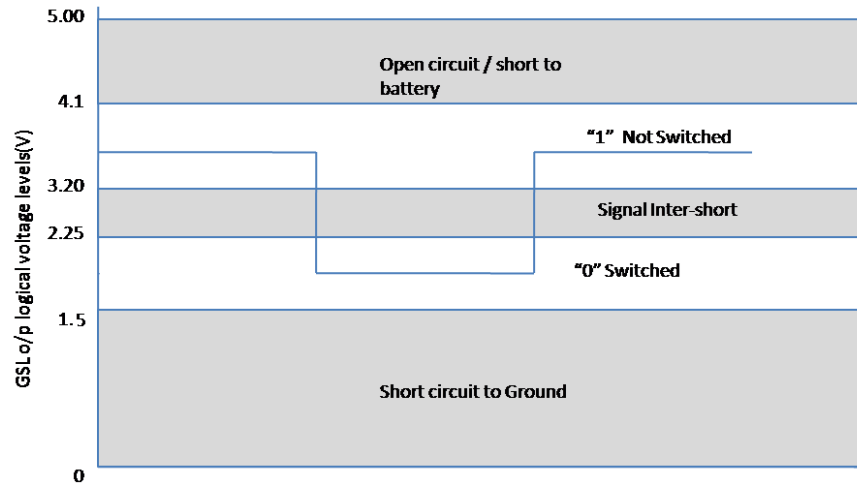
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7.4.3 GSL module output with pull up- logical voltage levels diagram



7.4.4 Protection

Parameter	Min	Nom	Max	Unit	Remarks
SC to Battery	> 4.1			V	Note ³
SC to Ground			< 1.5	V	Note ³
Open Circuit	> 4.1			V	Note ³

7.4.5 GSL operating level with pull up

% Vref	State	Terminal Voltage	
		Min	Max
82-100	Diagnostic Zone-3	4.1	5.0
65-82	State 1	3.2	4.1
46-64	Diagnostic Zone-2	2.25	3.2
31-45	State 0	1.5	2.25
0-30	Diagnostic Zone-1	0	1.5

7.5 Hardware details (TCU Type 2, Non TML PT)

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7.6 Connector Details

The header housing shall be integrated into the shifter design, connector pin numbers are as per specific supplier information.

Pin Number	Description (Gear shifter)
1	KL_31 (Gnd)
2	A4
3	KL_15 (Ign)
4	A1
5	A2
6	A3

7.7 Key Operating Conditions

7.7.1 Voltage Range

Supply Voltage Range (KL_15)	6 – 16 V
Operating Voltage (typical)	13.5V

7.7.2 Temperature Range

Operating Temperature	-40°C to 80°C
Storage Temperature	-40°C to 100°C

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