GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

TECHNICAL REPORT
ON
SOFTWARE MODIFICATIONS
IN
3-PHASE ELECTRIC LOCOMOTIVES

Report No. RDSO/2017/EL/RM/0179

January 2017

RESEARCH DESIGNS AND STANDARDS ORGANISATION
MANAKNAGAR, LUCKNOW – 226 011
GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

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<table>
<thead>
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<th>Signature</th>
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K.S. Yadav
A. Boddy
L. W. S.
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<td>53</td>
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</table>
FOREWORD

Indian Railways imported 22 WAG9 and 11 WAP5 Locomotives from M/s ABB, Switzerland in 1996-97 with Transfer of Technology (ToT). Later on Chittaranjan Loco Works (CLW) started its production. Each three phase Locomotive is equipped with two GTO/IGBT based Traction Converter for power supply to the Traction Motors. In addition to this, three GTO/IGBT based Auxiliary Converters are provided for power supply to Auxiliary motors. Two Vehicle Control units (VCU) control the functions of Locomotive.

Modifications in the software of Locomotive have been carried out from time to time for reliability as well as facilitating smooth train operation in IR condition. In this report, all the modifications have been complied at one place. This will facilitate easy understanding of the developments over the years. Moreover, nomenclature of the software version has been standardized in this report in consultation with OEMs/Zonal Railways. This report will be very useful to loco maintenance engineers of IR.
CHAPTER - 1

INTRODUCTION

Modifications in the software are a routine process necessitated from time to time due to operational and reliability requirements to facilitate troubleshooting, upgradation etc.

In this regards, a number of modifications have been carried out in GTO/IGBT converters software and MICAS & TCN VCU. At present, the responsibility to carry out the software modifications of the GTO based converter and MICAS VCU lies with CLW. Modified software versions are released for regular cut in after the satisfactory field performance and subsequent approval by RDSO. On the other hand, the software modifications for the IGBT converter and TCN VCU are carried out by the concerned manufacturers (OEMs). Details of the software modifications are informed to Railways as and when such modifications are carried out.

In order to appreciate the history of the software modifications, it is essential to understand the control system of the locomotive like the subsystems, configuration of the control electronics, bus stations, Multifunction Vehicle Bus (MVB), other data bus, programming languages used for the control software of the different processors. Considering this technical need, all the relevant details are explained in nine chapters of this report.
CHAPTER - 2

NOMENCLATURE OF SOFTWARE VERSION OF GTO LOCOMOTIVE

Control hardware of Locomotive has several processors segment which has its own control software. Thus the software of individual processor needs to be identified with the help of a unique software version.

The nomenclature adopted by ABB/BT for the original software version during the initial stage was such that it was not easily identifiable processor wise/loco wise. So it was felt that the software version nomenclature should be such that they can be easily linked to the type of the locomotive. Thus, in the year 2010, new software nomenclature was adopted.

As per new nomenclature, the version number has been assigned in four digit. First digit defines the variant of the loco to which the software is related. The next two digits indicate the year of issue of the main release and the last digit indicates the release number. The first release of the main issue shall be indicated by the 0 and for the subsequent releases the release number shall increase by one. This has been summarized as follows:

<table>
<thead>
<tr>
<th>Type of loco</th>
<th>No. Assigned</th>
</tr>
</thead>
<tbody>
<tr>
<td>WAP-5</td>
<td>1</td>
</tr>
<tr>
<td>WAP-7</td>
<td>2</td>
</tr>
<tr>
<td>WAG-9</td>
<td>3</td>
</tr>
<tr>
<td>WAG-9H</td>
<td>4</td>
</tr>
</tbody>
</table>

Nomenclature

R–2100

2 10 0

YY – Year of Release 10 for 2010

Version of the Release
0 – Main Release
Subsequent no. will identify the patch.

Fig-1: Nomenclature of Software
After the change in the nomenclature, the first software release issued in year 2010 for the different variants was as follows:

<table>
<thead>
<tr>
<th>SN</th>
<th>Type of Loco</th>
<th>Initial software Release</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>WAP-5</td>
<td>R-1100</td>
</tr>
<tr>
<td>2</td>
<td>WAP-7</td>
<td>R-2100</td>
</tr>
<tr>
<td>3</td>
<td>WAG-9</td>
<td>R-3100</td>
</tr>
<tr>
<td>4</td>
<td>WAG-9H</td>
<td>R-4100</td>
</tr>
</tbody>
</table>
CHAPTER - 3

PRINCIPLE OF LOCO CONTROL, ITS ARCHITECTURE AND SOFTWARE

3.1 The control electronics arrangement

The 3-Phase locomotive control system is microprocessor based. There are 7 bus stations (Control electronics). Their interconnections are shown below:

Fig-2: Control Electronics Arrangements
3.2 Different types of Buses are used for communication purpose in Locomotive. These Buses are

(i) **MVB (MICAS vehicle Bus or Multifunctional Vehicle Bus)**

Connects the processors of a vehicle to form an integrated data system with fast data transfer rate (1.5 MBaud). It is part of MICAS-S2 control and is proprietary in nature.

(ii) **AMS Bus (Local data bus in a 6U bus station)**

For data transfer between Digital and Analogue IOs and the processor cards.

(iii) **P Bus (Local data bus in a 3U bus station)**

Used in BUR for control of the configuration contactors.

(iv) **Local Bus**

Used to bridge the data between FUPLA code for the display logic and C-code for DDU control.

(v) **MICAS (Micro Computer Automation System) Train Bus**

Used for data communication between locomotives in MU consist. It is ABB proprietary.

(vi) **WTB (Wired Train Bus)**

Used for data communication between locomotives in MU consist in TCN VCU.
3.3 Bus interface Architecture within VCU1 is shown below

![Fig-3: VCU-1 Bus Interface](image)

3.4 Bus interface Architecture within VCU2 is shown below

![Fig-4: VCU-2 Bus Interface](image)
3.5 Bus interface Architecture within SR Electronics is shown below

Fig-5: SR Bus Interface

3.6 Bus interface Architecture within BUR Electronics are shown below

Fig-6: BUR Bus Interface
3.7 The different processor and their assigned functions are shown below:

FLG1,2 : Overall loco control
SLG1,2 : Overall controller for Bogie 1 and Bogie2
NSC1,2 : Controller for Rectifier
ASC1,2 : Controller for Inverter
STB1,2 : Low Voltage controller
HBB1,2 : Controller for Cabs
FBV1,2 : Vehicle bus Administrator
ZBV : Train bus Administrator
DIA : Diagnostic Computer
DDA1,2 : Driver display controller
BUR1,2,3: Auxiliary Converter Controller

3.8 Processors and Programming Language

<table>
<thead>
<tr>
<th>Bus Station</th>
<th>Processor</th>
<th>Programming Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCU</td>
<td>FLG1/FLG2</td>
<td>FUPLA</td>
</tr>
<tr>
<td></td>
<td>HBB1/HBB2</td>
<td>FUPLA</td>
</tr>
<tr>
<td></td>
<td>STB1/STB2</td>
<td>FUPLA</td>
</tr>
<tr>
<td></td>
<td>DDA1/DDA2</td>
<td>FUPLA + C</td>
</tr>
<tr>
<td></td>
<td>DIA1</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>FBV1/FBV2</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>ZBV1</td>
<td>Not known</td>
</tr>
<tr>
<td>SR</td>
<td>SLG1/SLG2</td>
<td>FUPLA</td>
</tr>
<tr>
<td></td>
<td>ASC1/ASC2</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>NSC1/NSC2</td>
<td>C</td>
</tr>
<tr>
<td>BUR</td>
<td>BUR1/BUR2/BUR3</td>
<td>FUPLA</td>
</tr>
</tbody>
</table>
3.9 Locomotive controls all the equipment and monitoring of their status with sensor interfaces. The details of the sensor interfaces with the control electronics is given below:

**Vehicle Control Unit (VCU)**

- Master controller analogue signal
- Master controller cam digital signal

**Traction converter**

- TM speed sensor
- TM temperature sensor
- TFP temperature sensor
- TFP pressure sensor (through differential amplifier)
- SR coolant temperature sensor
- SR coolant pressure sensor
- Various voltage and current sensors
3.10 List of parameters monitored using different sensors in loco

1. AC Primary Voltage (Cooling Mode)
2. AC Primary Voltage (Driving Mode)
3. AC Primary Current
4. AC Primary Input Current (Hardware Function)
5. Harmonic Filter Current
6. Hotel Load Current
7. Auxiliary Current
8. Vehicle Speed, Motor Speed
9. Traction Motor Temperatures
10. Transformer Oil Pressure
11. Transformer Temperature
12. Converter coolant Pressure
13. Converter coolant Temperature
14. DC-Link Voltage Main Converter
15. Earth fault Detection Main Converter
16. Pressure Capacitor DC-Link
17. Earth fault Battery Circuit
18. Earth fault Hotel Load Supply
19. Earth fault Auxiliary Circuit
20. Earth fault 415V/110V Circuit
21. Earth fault Filter Circuit
3.11 The loco control has been divided into sub systems. Overview of the sub systems is given below:

SS01  Main power supply
SS02  Traction bogie 1
SS03  Traction bogie 2
SS04  Harmonic Filter
SS05  Hotel load
SS06  Converter, auxiliary circuits 1
SS07  Converter, auxiliary circuits 2
SS08  Converter, auxiliary circuits 3
SS09  Battery system
SS10  Brake system
SS11  Auxiliary circuits HB 1
SS12  Auxiliary circuits HB 2
SS13  Driver's cab 1
SS14  Driver's cab 2
SS15  Fire alarm
SS16  Speed indicator
SS17  FLG 1
SS18  FLG 2
SS19  Train BUS
CHAPTER– 4

SOFTWARE MODIFICATIONS (UNDER TRIAL) IN GTO BASED TRACTION AND AUXILIARY CONVERTER

4.1 Improvement of the adhesion of the WAP-7 locomotive

- During 2013-14, BT/Switzerland had carried out a number of trials in WAG-9 under ELS/GMO to improve the adhesion.
- The modifications have since been adopted in all the WAG-9 and WAG-9H locomotives across all the sheds.
- There was substantial improvement in the loco adhesion performance.
- It has been envisaged to carry out the similar modifications in the WAP-7. Work for the same has been completed in-house by RDSO and CLW and the modified software is under trial.

4.2 Software modification to increase the trigger range of temperature disturbance DDS from present 10 degree Celsius to 25 degree Celsius.

- This modification is required to prevent the withdrawal of the locomotives due to temperature disturbance message.
- This modification does not hamper the existing temperature sensing logic.
- The modification has been completed and patch will be released on trial basis along with the adhesion improvement modification
4.3 **OHE voltage limit in FLG processor**

- At present the OHE voltage out of limit signal is triggered by FLG1 or FLG2 when the voltage crosses 29 kV.
- Separate OHE voltage limits have been defined in SLG as “In case the OHE voltage is more than 30 kV and less than 31 kV the loco will shut down in one second. In case the OHE voltage is more than 31 kV the loco will shut down instantaneously.
- It is observed that the rather lenient OHE voltage limits are defined in FLG which can be do away with.
- Thus, same limit has been set in the FLG also to eliminate the failures in case OHE voltage is between 29 kV to 30 kV.
- Software modification has been carried out and trial software release is under implementation.

4.4 **Modification of the SR oil temperature limits**

- Railways have reported cases of SR temperature high during the summer. RDSO has studied the issue and in association with CLW, carried out modification in SR oil temperature setting as follows:
  - Lower limit – increased from 64 to 65 deg C
  - Upper limit – increased from 66 to 67 deg C

![SR Oil Temperature vs Output Power](image)

**Fig-7: SR Oil Temperature Protection**
CHAPTER – 5

MODIFICATIONS IN SOFTWARE OF GTO TRACTION / AUXILIARY CONVERTER

5.1 Software version :-
   2140

5.1.1 Details of the modification :-
   Cab redundancy along with reliability improvement features incorporated.

5.1.2 Date of issue :-
   01.09.15

5.1.3 Type of Loco applicable :-
   WAP-7

5.1.4 Affected Processor :-
   All VCU processor except ZBV

5.2 Software version :-
   4140 & 3140

5.2.1 Details of the modification :-
   Cab redundancy along with reliability improvement features incorporated.

5.2.2 Date of issue :-
   23.06.15

5.2.3 Type of Loco applicable :-
   WAG-9H & WAG-9

5.2.4 Affected Processor :-
   All VCU processor except ZBV
5.3 Software version :-
    3132 & 4132 for SLG1 and SLG2
5.3.1 Details of the modification :-
    Software modification done to improve the Slip Slide performance of 3-ph
    Locomotives. Software modified for the processors NSC/ASC and
    SLG1/SLG2
5.3.2 Date of issue :-
    23.09.13
5.3.3 Type of Loco applicable :-
    WAG-9H & WAG-9
5.3.4 Affected Processor :-
    ASC1, ASC2, NSC1, NSC2, SLG1 & SLG2

5.4 Software version :-
    Software modification for BUR
5.4.1 Details of the modification :-
    BUR Software modification to improve loco reliability and monitoring the
    BUR contactor. Software modification for sensing auxiliary interlocks of
    contactors 52.5/1 and 52.4/2 and generating appropriate message to
    Drivers for contactor stuck off. Software modification to start BUR-2 at 50
    Hz.
5.4.2 Date of issue :-
    31.08.13
5.4.3 Type of Loco applicable :-
    WAP-5, WAP-7, WAG-9 & WAG-9H
5.4.4 Affected Processor :-
    BUR1, BUR2, BUR3
<table>
<thead>
<tr>
<th>Processor</th>
<th>DDS Number</th>
<th>DDS Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUR-2</td>
<td>0024</td>
<td>Cont. 52.4/1 or 52.5/2 Stuck</td>
</tr>
<tr>
<td></td>
<td>0025</td>
<td>Cont. 52.4/2 or 52.5/1 stuck</td>
</tr>
<tr>
<td>BUR-3</td>
<td>0020</td>
<td>Cont. 52.4/1 or 52.5/2 stuck</td>
</tr>
<tr>
<td></td>
<td>0021</td>
<td>Cont. 52.4/2 or 52.5/1 stuck</td>
</tr>
</tbody>
</table>

5.5 **Software version :-**

1131, 2131, 3131 & 4131 for SLG1 and SLG2

5.5.1 **Details of the modification :-**

Modification done in ALG & SLG to address the various error messages. Modification done to change the temperature sensing logic. Modification also done in ASC and NSC processors.

(i) Modification in ALG & SLG to address the following error messages:

<table>
<thead>
<tr>
<th>Processor</th>
<th>DDS message</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASC1/2</td>
<td>ASC1/2:0074-ADC time out</td>
</tr>
<tr>
<td>ASC1/2</td>
<td>ASC1/2:Error clock frequency 1</td>
</tr>
<tr>
<td>SLG1/2</td>
<td>SLG1/2: Dist. Communication ASC-SLG</td>
</tr>
<tr>
<td>SLG1/2</td>
<td>SLG1/2: Dist. Communication NSC-SLG</td>
</tr>
<tr>
<td>SLG1/2</td>
<td>SLG1/2: Life sign from FLG missing</td>
</tr>
<tr>
<td>SLG1/2</td>
<td>SLG1/2: SLG1 pulsing stopped</td>
</tr>
<tr>
<td>SLG1/2</td>
<td>SLG1/2: NSC1 pulsing stopped</td>
</tr>
<tr>
<td>SLG1/2</td>
<td>SLG1/2: Time out ALG without PTO</td>
</tr>
<tr>
<td>SLG1/2</td>
<td>SLG1/2: Verification bogie Bur1 disturb</td>
</tr>
</tbody>
</table>
(ii) Modified logic of temperature sensing.

“If the temperature sensed by any one of the two sensors is more than 75° C and the different between the two sensor readings is more than 25° C then lower of the two readings will be decisive.”

5.5.2 Date of issue :-
29.07.13

5.5.3 Type of Loco applicable :-
WAP-5, WAP-7, WAG-9 & WAG-9H

5.5.4 Affected Processor :-
ASC1, ASC2, NSC1, NSC2, SLG1&SLG2

5.6 Software version :-
1130, 2130, 3130 & 4130

5.6.1 Details of the modification :-

Creation of common and uncommon software.

<table>
<thead>
<tr>
<th>Controller</th>
<th>Processor</th>
<th>WAP5</th>
<th>WAP7</th>
<th>WAG9</th>
<th>WG9H</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCU</td>
<td>FLG1</td>
<td>1130</td>
<td>2130</td>
<td>3130</td>
<td>4130</td>
</tr>
<tr>
<td></td>
<td>FLG2</td>
<td>1130</td>
<td>2130</td>
<td>3130</td>
<td>4130</td>
</tr>
<tr>
<td>SR</td>
<td>SLG1</td>
<td>1130</td>
<td>2130</td>
<td>3130</td>
<td>4130</td>
</tr>
<tr>
<td></td>
<td>SLG2</td>
<td>1130</td>
<td>2130</td>
<td>3130</td>
<td>4130</td>
</tr>
</tbody>
</table>

Prepared by

Checked by

Issued by
### Common Software

<table>
<thead>
<tr>
<th>Controller</th>
<th>Processor</th>
<th>Version/date file created</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCU</td>
<td>HBB1</td>
<td>0130</td>
</tr>
<tr>
<td></td>
<td>HBB2</td>
<td>0130</td>
</tr>
<tr>
<td></td>
<td>STB1</td>
<td>0130</td>
</tr>
<tr>
<td></td>
<td>STB2</td>
<td>0130</td>
</tr>
<tr>
<td></td>
<td>FBV1</td>
<td>03.06.2010</td>
</tr>
<tr>
<td></td>
<td>FBV2</td>
<td>03.06.2010</td>
</tr>
<tr>
<td></td>
<td>DDA1</td>
<td>12.03.2013</td>
</tr>
<tr>
<td></td>
<td>DDA2</td>
<td>12.03.2013</td>
</tr>
<tr>
<td></td>
<td>DIA1</td>
<td>15.04.2011</td>
</tr>
<tr>
<td></td>
<td>ZBV1</td>
<td>19.01.1999</td>
</tr>
<tr>
<td>SR</td>
<td>ASC1</td>
<td>14.03.2013</td>
</tr>
<tr>
<td></td>
<td>ASC2</td>
<td>14.03.2013</td>
</tr>
<tr>
<td></td>
<td>NSC1</td>
<td>14.03.2013</td>
</tr>
<tr>
<td></td>
<td>NSC2</td>
<td>14.03.2013</td>
</tr>
<tr>
<td>BUR</td>
<td>BUR1</td>
<td>04.06.2010</td>
</tr>
<tr>
<td></td>
<td>BUR2</td>
<td>04.06.2010</td>
</tr>
<tr>
<td></td>
<td>BUR3</td>
<td>04.06.2010</td>
</tr>
</tbody>
</table>
Modifications details

(i) Includes all the software modifications carried out till the latest software patch released vide letter No. C-D&D/T/21 dated 08.09.2012.

(ii) No traction in case of inching mode while parking brake applied.

(iii) Provision of operation of WAP-5 loco in multi with only one pantograph in raised condition. Software has been modified such that this functionality will enable only when WAP-5 class of locos are formed in multi consist. It will not have any affect on the functionality of WAG-9 in multi or operation of any variant as single loco.

(iv) Modification in message F0108P1. Message will be as follows on Driver Display:

Line two-“Primary over current”.
Line three- “Check over current relay flag”.
Line four- “Close VCB after unlocking relay”.

(v) Introduction of new message No. F1106P2 while loco in shunting mode. Following messages are displayed whenever the loco is put into shunting mode and throttle is given.

Line one -“Loco in shunting mode”.
Line two -“Speed cannot be more than 15 kmph”

(vi) Relaxing of Brake Electronics failed message. Disturbance monitoring Window has been increased from 0.2 sec. to 1.2 sec to suppress the spurious signal.

(vii) Change in the fault message related to message No. F1001P1. The new message will be as follows:

Line two -“fault in brake electronics”.
Line three -“Full service brake applied”.
Line four -“No traction allowed”.

All the modifications related to interfacing to Driver Display Unit (DDU) and Remote Diagnostic System (RDS) are included. Therefore, after downloading this software, all the locos shall be ready for installation of DDU and RDS without any further modification.
5.6.2 Date of issue :-
03.04.13

5.6.3 Type of Loco applicable :-
WAP-5, WAP-7, WAG-9 & WAG-9H

5.6.4 Affected Processor :-
All processors

5.7 Software version :-
1104, 2104, 3104 & 4104 for FLG1 and FLG2

5.7.1 Details of the modification :-
Software modification has been done for "Lifesign missing" problem from all processor cards (except NSC-1, NSC-2 and ASC-1, ASC-2). The modification has been carried out in FLG1 and FLG2

5.7.2 Date of issue :-
08.09.12

5.7.3 Type of Loco applicable :-
WAP-5, WAP-7, WAG-9 & WAG-9H

5.7.4 Affected Processor :-
FLG1 & FLG2

5.8 Software version :-
No version number

5.8.1 Details of the modification :-
During the 35th MSG, it was decided to modify the software logic for monitoring of temperature of TFP. A software modification was done earlier to tackle the problem of temperature sensor failure in traction motor. In similar line this software logic will be applied to the TM temperature also. The software logic shall be as follows;
“If the temperature read by any one of the two sensors is more than 750°C and the difference between the two sensors reading is more than 250°C then the lower of the two readings will be decisive”

5.8.2 Date of issue :-
08.09.12

5.8.3 Type of Loco applicable :-

5.8.4 Affected Processor :-

5.9 Software version :-
No version number is allocated to ASC and NSC

5.9.1 Details of the modification :-
Software modification by M/s BTIL in NSC and ASC. The modification has been carried out to relax the protection limits for the following messages;

(i) Error plausibility,
(ii) Error comparator,
(iii) Error transducer and
(iv) Error calibrator.

5.9.2 Date of issue :-
31.07.12

5.9.3 Type of Loco applicable :-
WAP-5, WAP-7, WAG-9 & WAG-9H

5.9.4 Affected Processor :-
ASC1, ASC2, NSC1 & NSC2
5.10 Software version :-
No version number

5.10.1 Details of the modification: -
Software modification done in the tolerance band of master controller from 60% to 45%.

5.10.2 Date of issue :-
28.08.12

5.10.3 Type of Loco applicable :-
WAP-5, WAP-7, WAG-9 & WAG-9H

5.10.4 Affected Processor :-

5.11 Software version :-
1103, 2103, 3103 & 4103 for FLG1 and FLG2

5.11.1 Details of the modification :-
Software modification for additional features in Graphical Driver Display and Remote Diagnostic System.

5.11.2 Date of issue :-
26.06.12

5.11.3 Type of Loco applicable :-
WAP-5, WAP-7, WAG-9 & WAG-9H

5.11.4 Affected Processor :-
FLG1 and FLG2

5.12 Software version: -
1101, 2101, 3101 & 4101 for HBB1 and HBB2

5.12.1 Details of the modification :-
Software modification to change the unloading timings. Modification done in HBB1 and HBB2.
5.12.2 Date of issue :-
10.03.12

5.12.3 Type of Loco applicable :-
WAP-5, WAP-7, WAG-9 & WAG-9H

5.12.4 Affected Processor :-
HBB1 and HBB2

5.13 Software version: -
1102, 2102, 3102 & 4102 for FLG1 and FLF2

5.13.1 Details of the modification: -
Software Modification to relax the parameter of BUR life sign missing.

5.13.2 Date of issue :-
28.02.12

5.13.3 Type of Loco applicable :-
WAP-5, WAP-7, WAG-9 & WAG-9H

5.13.4 Affected Processor :-
FLG1 and FLF2

5.14 Software version: -
1102, 2102, 3102 & 4102 for STB1

5.14.1 Details of the modification: -
Recording of isolation of VCD with additional feature of display of message in DDS.

Fig-8: Unloader Valve Timing
5.14.2 Date of issue :-

10.08.11

5.14.3 Type of Loco applicable :-

WAP-5, WAP-7, WAG-9 & WAG-9H

5.14.4 Affected Processor :-

STB1, DDA1 and DDA2

5.15 Software version :-

1101, 2101, 3101, 4101 for FLG1, FLG2 and STB1

5.15.1 Details of the modification :-

• Isolation of bogie without switching off of MCE using rotary switch no. 154.
• Recording of isolation of VCD' in DDS.
• Recording of MCE switching off time in DDS.
• Detection of stuck-on position of BPCS switch and bringing the loco out of the constant speed loop if BPCS stuck-on position is detected.

5.15.2 Date of issue :-

13.05.11

5.15.3 Type of Loco applicable :-

WAP-5, WAP-7, WAG-9 & WAG-9H

5.15.4 Affected Processor :-

FLG1, FLG2 and STB1

5.16 Software version :-

1100, 2100, 3100&4100

5.16.1 Details of the modification :-

Standardization of the loco software running in different variants. The main features:

• Project versions of all the variants have been made.
• Project version of all the variants will become same.

<table>
<thead>
<tr>
<th>Prepared by</th>
<th>Checked by</th>
<th>Issued by</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
• The software for BUR 1, BUR 2, BUR 3 and DDA 1, DDA 2 and DIA, FBV 1, FBV 2 and ZBV will be same for all variants.

• PIXY display shall be same for all variants (earlier for WAP-5 & WAP-7 some of the features were not available).

• Software release number for WAP-5 & WAP-7 will be displayed on the PIXY (earlier this feature was not available).

• All the modifications till date have been incorporated in these releases.

• These releases include all the modifications required for installation of graphical Driver Display Unit (DDU) and Remote Diagnostic System (RDS). Therefore, the loco will be ready for installation of RDS and DDU.

• Incorporation of logic of regeneration of energy in slave locomotive in MU consists.

5.16.2 Date of issue :-
31.01.11

5.16.3 Type of Loco applicable :-
WAP-5, WAP-7, WAG-9 & WAG-9H

5.16.4 Affected Processor :-
All processors
CHAPTER – 6

NOMENCLATURE OF SOFTWARE VERSION OF IGBT CONVERTERS

Control hardware of Locomotive has several processors segment which has its own software. Thus the software of individual processor needs to be identified with the help of a unique software version.

The nomenclature adopted by converter manufacturer is very different such as M/s ABB uses 26, 27 etc., M/s BT uses R_1220, R_1225 etc. M/s BHEL uses 312,313 etc. and M/s MEDHA uses 1.01, 1.02 etc. for Traction converter. The nomenclature adopted by converter manufacturer for Auxiliary Converter are also different like M/s ABB uses 10081, 10082 etc., M/s BHEL uses 169.4, 171, 171.1 etc., M/s MEDHA uses 2.01, 2.06 etc. and M/s HIRECT uses V_31_38_02_38, V_31_39_02_33, V1.01 etc.

Therefore, it is felt that the software version nomenclature should be standardized that they can be easily linked to the type of the locomotive, years of release, manufacturer (OEM) and Electric Loco shed can make out these version easily for daily maintenance.

Therefore, software nomenclature has been standardized as per details given below.

As per new nomenclature, the version number has been assigned in eight Alfa numeric digits. First digit defines the variant of the loco to which the software is related. The second & third digits indicate the year of issue of the main release, forth alphabet indicate the equipment, fifth and sixth digit indicates the release number and last two alphabet indicate the manufacturer(OEM). The first release of the main issue shall be indicated by the 0 and for the subsequent releases the release number shall increase by one. If nomenclature adds with prefix ‘T’ means the software version for trial. This has been summarized as follows:

A typical sample of nomenclature of software of IGBT Traction converter of M/s BT for version ‘1’

<table>
<thead>
<tr>
<th>Nomenclature</th>
<th>4 16 T 01 BT</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Digit</td>
<td></td>
</tr>
<tr>
<td>Second &amp; third Digit</td>
<td></td>
</tr>
<tr>
<td>Forth Alphabet</td>
<td></td>
</tr>
<tr>
<td>Fifth &amp; Six Digit</td>
<td></td>
</tr>
<tr>
<td>Seventh &amp; Eighth Alphabet</td>
<td></td>
</tr>
</tbody>
</table>

Prepared by

Checked by

Issued by
Definition of the digit used in nomenclature:

1. First Digit:

<table>
<thead>
<tr>
<th>Type of Loco</th>
<th>Assigned No.</th>
</tr>
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<tbody>
<tr>
<td>WAP5</td>
<td>1</td>
</tr>
<tr>
<td>WAP7</td>
<td>2</td>
</tr>
<tr>
<td>WAG9/9H</td>
<td>3</td>
</tr>
<tr>
<td>All Loco</td>
<td>4</td>
</tr>
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</table>

2. Second & Third Digit:
   Year of Release
   16 for the year 2016

3. Fourth Alphabet: For Equipments

<table>
<thead>
<tr>
<th>Type of Equipment</th>
<th>Assigned Alphabet</th>
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</thead>
<tbody>
<tr>
<td>Auxiliary Converter</td>
<td>A</td>
</tr>
<tr>
<td>Traction Converter</td>
<td>T</td>
</tr>
<tr>
<td>VCU</td>
<td>V</td>
</tr>
<tr>
<td>Applicable to all</td>
<td>W</td>
</tr>
</tbody>
</table>

4. Fifth & Sixth Digit:
   Version of release
   00 to 99

5. Seventh & Eighth Alphabet: for manufacturer

<table>
<thead>
<tr>
<th>Manufacturer (OEM)</th>
<th>Assigned Alphabet</th>
</tr>
</thead>
<tbody>
<tr>
<td>M/s AAL</td>
<td>AL</td>
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<tr>
<td>M/s ABB</td>
<td>AB</td>
</tr>
<tr>
<td>M/s BHEL</td>
<td>BH</td>
</tr>
<tr>
<td>M/s BT</td>
<td>BT</td>
</tr>
<tr>
<td>M/s CGL</td>
<td>CG</td>
</tr>
<tr>
<td>M/s HIRECT</td>
<td>HR</td>
</tr>
<tr>
<td>M/s MEDHA</td>
<td>MD</td>
</tr>
</tbody>
</table>
CHAPTER –7

MODIFICATIONS IN SOFTWARE OF IGBT TRACTION CONVERTERS

(A) IGBT BASE TRACTION CONVERTER SOFTWARE SUMMARY OF M/s ABB

7.1 Software version :-

26

7.1.1 Revised Nomenclature of software:-

4 12 T 00 AB

7.1.2 Details of the modification: -

First software release for the serial production locomotive based on prototype field trial.

7.1.3 Date of issue :-

May-2012

7.2 Software version :-

27

7.1.4 Revised Nomenclature of software:-

4 12 T 01 AB

7.2.1 Details of the modification :-

First WAP-7 Commissioning issue:

Calculation of slip/slide activation feedback to vehicle control during torque ramps with zero crossing corrected.

7.2.2 Date of issue :-

15.10.2012

7.3 Software version :-

28

7.1.5 Revised Nomenclature of software:-

4 12 T 02 AB

7.3.1 Details of the modification :-

Trip message of the converter transferred to each other through PEC to PEC link to avoid the generation of intermediate frequency in filter winding, which causing locomotive trip „Harmonic Filter Over Current“.

7.3.2 Date of issue :-

30.11.2012
7.4 Software version :-
29

7.1.6 Revised Nomenclature of software:-
4 12 T 03 AB

7.4.1 Details of the modification :-
First WAP-7 Commissioning issue:
- Initial value of train mass estimation set at middle to reach the correct activation in shorter time to avoid slip/slide affect. (LSP Reason: Initial value was set to a maximum train mass and as this estimation functionality requires some time to tune to detect the actual value. As a result, the estimated mass was not set properly leading to a slip/slide effect initially.)
- Time gap between filter contactor set-up and LC pulse release is increased to avoid the LC over current tripping.
- Supervision of OHE voltage Improved to resolve the issue with the OHE voltage low not being reported in some cases.
- Improved logic for the reporting of a Power reduction to the FLG (issue with message "TE/BE Fully restored").

7.4.2 Date of issue :-
07.12.2012

7.5 Software version :-
30

7.5.1 Revised Nomenclature of software:-
4 12 T 04 AB

7.5.2 Details of the modification :-
First WAP-7 Commissioning issue:
- Time constant for the LSP lamp glowing is tuned according to
  - Initial value of train mass estimation.

7.5.3 Date of issue :-

7.6 Software version :-
31

7.6.1 Revised Nomenclature of software:-
4 13 T 05 AB
7.6.2 Details of the modification :-
- Supervision of the trip signal (which is received from other converter via PEC to PEC link) is improved to avoid the bogie isolation while isolating the other bogie.
- Speed sensor feedback of the isolated bogie will not be used by healthy bogie (received through PEC to PEC link) and will not be sent to VCU through MVB link.

7.6.3 Date of issue :-
12.01.2013

7.7 Software version :-
32
7.7.1 Revised Nomenclature of software:-
4 13 T 06 AB
7.7.2 Details of the modification :-
- Supervision of the “charging failure” improved to avoid the tripping due to input voltage distortion.
- Triggering condition of the “VCU Cmd time out” alarm logging is fine tuned.
- To avoid the tripping of converter due to transformer pressure low during compressor sequence, delay time threshold increased from 10s to 20.

7.7.3 Date of issue :-
19.06.2013

7.8 Software version :-
33
7.8.1 Revised Nomenclature of software:-
4 13 T 07 AB
7.8.2 Details of the modification :-
- Logic of the uD failure is improved to avoid the furious tripping.
- Isolation of the respective motor converter while the failure of speed sensor is implemented.
- It has been identify that line over current is coming while initializing the line current but not able to find the root cause. To investigate the root cause of tripping, required to monitor the few parameters are added in transient recorder.
• Scaled parameter of converter monitored current, speed & tractive effort added for Bordline View monitoring.

7.8.3 Date of issue :-
14.10.2013

7.9 Software version :-
34

7.9.1 Revised Nomenclature of software:-
4 13 T 08 AB

7.9.2 Details of the modification :-
• Signals related to the HF contactor and Bogie selection communication advanced to avoid mismatch of the bogie selection logic in FLG.
• Flow sensor logic has been improved to avoid the tripping of the converter in case of Coolant flow become low due to OHE voltage dip & traction converter running condition. Converter tractive effort will be reduced when the coolant flow reduced to zero and again adjusted back to demand tractive effort level after flow level is within limit.
• Flow sensor failing will isolate the respective converter only after 2 attempts, not both the converter.
• Improved the speed sensor failure detection logic for two speed sensor failure.
• File management system to store the TR files has been upgraded to avoid the failure of flash memory data which cause the software corruption.
• Logic to issue the “Converter Initialization over” signal has modified in such a way so that, once the converter start communication, this signal will be issued to FLG to avoid the possibility of time delay which cause the FLG tripping of “Timeout Initialization”.

7.9.3 Date of issue :-
12.12.2013

7.10 Software version :-
35

7.10.1 Revised Nomenclature of software:-
4 14 T 09 AB
7.10.2 Details of the modification :-
- Converter redundancy logic updated for the GD PS-2 failure, so whenever there is GD PS-2 get failed only one Line converter & one Motor converter get isolate.
- Line converter over current tripping is fine tune to avoid the tripping.
- DDS logic along with environment data has been updated in the software (Currently DDS is disabled, since the respective modified DIA file need to update), so that the respective DDS will generate for converter trip.
- Converter will issue the trip command only if there is a fault in converter itself and not during the „Trip on Remote converter“.
- Additional message (DCU_Isol_Demand) added, when converter request isolation demand to VCU.

7.10.3 Date of issue :-
06.10.2014

7.11 Software version :-
36

7.11.1 Revised Nomenclature of software:-
4 15 T 10 AB

7.11.2 Details of the modification :-
- DDS logic along with environment data has been activated in the software
- Data for Traction converter can be downloaded from „DIA“ card of VCU like other subsystem
- In DDS there is defined message display in case of TM failure
- Regeneration braking issue solved by correcting the „Speed valid bit“ logic, which was getting stuck in Forward direction in CAB-2 & Reverse direction in CAB-1 at the first instant after control supply.
- Time synchronization with VCU: Time stamp of PEC will be updated from VCU every hour to avoid the time gap between VCU & PEC.
- TM Isolation logic is improved and will be isolated above 1.5 kmph. issue resolved (if any one speed sensor failed, and particular motor converter only will get isolate, instead of bogie isolation)
- UL_L_Pantoup & Expansion Vessel Warning, these both informative event but not related to the failure has been removed.
- Line converter control is improved to avoid the Harmonic filter over current at lower power.

7.11.3 Date of issue :-
09.07.2015
7.12 Software version :-
   37
7.12.1 Revised Nomenclature of software:-
   4 16 T 11 AB
7.12.2 Details of the modification :-
   Following trip logic and parameter improved to avoid the furious tripping and to improve the performance
   • Timeout Initialization End B1/B2
   • Timeout Release shutdown B1/B2
   • Timeout ASC/NSC Pulse B1/B2
   • Time out DC link charge ckt B1/B2,
   • Timeout Pre-charge end B1/B2
   • Harmonic Filter not Isolating during stuck & node not increasing (8.1/8.2/8.41)
   • Harmonic Filter Over current (I_Flt_HH)
   • Unwanted event (Invalid ID)
   • DC Link voltage high (UDHH_1, UDHH_2 & UDHH_3)
   • DDS mapping and text corrected for : Coolant Level >Limit, Invalid ID, Input Voltage Low, Coolant flow Low, Blank Messages, GDPS501 & 502
   • Loco creeping/wheel slip-slide Logic
   • WAP5: speed jerk & MC over current issue addressed
   • FLG 1 & 2 redundancy
   • DDS Message: Bifurcation of HF Contactor stuck on and stuck off messages has been implemented
   • Traction converter parameter made available at DDU.
7.12.3 Date of issue :-
   03.03.2016
7.13 **Software version :-**
37- modified under trial

7.13.1 **Revised Nomenclature of software :-**
T 4 16 T 11 AB

7.13.2 **Details of the modification :-**

Following trip logic and parameter further improved to avoid the furious tripping
- DC Link Over voltage
- Harmonic Filter over current
- Pre-charge Block and Timeout pre-charge
- Timeout Release Shutdown
- Implementation of Loco creeping and Wheel Slip/slide warning message.

7.13.3 **Date of issue :-**
12.10.2016
(B) IGBT BASE TRACTION CONVERTER SOFTWARE SUMMARY OF M/s BT

7.14 Software version :-
   WAG-9R_1220

7.14.1 Revised Nomenclature of software:-
   4 16 T 00 BT

7.14.2 Details of the modification :-
   • Drive direction failure related function and supervision improved.
   • Fixing problem for DDS "Time-out LC pulse B1/B2".
   • Fixing problem for DDS "Time-out DC-Link Charge B1/B2".
   • DDA 1/DDA2 Lifesign problems for DDS "Emergency Brake Vigilance" and "Speedometer failed" messages.

7.14.3 Date of issue :-
   03.03.2016

7.15 Software version :-
   WAP-7R_1225

7.15.1 Revised Nomenclature of software:-
   4 16 T 01 BT

7.15.2 Details of the modification :-
   • Cab redundancy along with reliability improvement features incorporated.
   • Hotel Load winding current measurement and protection by Traction Converter.
   • Drive direction failure related function and supervision improved.
   • Fixing problem for DDS "Time-out LC pulse B1/B2".
   • Fixing problem for DDS "Time-out DC-Link Charge B1/B2".
   • DDA1/DDA2 Lifesign problems for DDS "Emergency Brake Vigilance" and "Speedometer failed" messages.

7.15.3 Date of issue :-
   29.04.2016
(C) IGBT BASE TRACTION CONVERTER SOFTWARE SUMMARY OF M/s BHEL

7.16 Software version :-
312

7.14.4 Revised Nomenclature of software:-
4 13 T 00 BH

7.16.1 Details of the modification :-

Line voltage measurement
- During simulation mode the pantograph is down.
- In situations that the catenary is earthed, the voltage on the pantograph practically zero.
- In situations that the catenary is not earthed, the voltage on the pantograph is approximately 2kV caused by induction.
- The difference between the two cases causes different behavior in simulation mode. Therefore an artificial line voltage generator is added which is active in simulation mode (and in type-test settings activated). This line voltage is then used for synchronizing the PLL and thus determining the interrupt frequencies

Panto Bounce detection
- The Panto bounce detection, based on the PLL and the Voltage Break function, is adapted in such a way that during simulation mode it cannot be activated.

7.16.2 Date of issue :-
07.01.2013

7.17 Software version :-
313

7.14.5 Revised Nomenclature of software:-
4 13 T 01 BH

7.17.1 Details of the modification :-

Line Current Limit corrected
Following parameters Line Current Limit changed:
- FQC_IL_Lim_Pos 2666A → 1400A
- FQC_IL_Lim_Neg2666A → 1400A
Not used Fault handling signals removed
- All signals from DCU1/PM4/leg2 and DCU3/PM3/Leg1 are switched off in the fault handling table.
- These legs are part of the power module 15A8 which is steered from two DCU’s (DCU1 and DCU3).

7.17.2 Date of issue: -
02.03.2013

7.18 Software version: -
314
7.18.1 Revised Nomenclature of software: -
4 13 T 02 BH
7.18.2 Details of the modification: -
Max line voltage reduced
Following parameter changed:
OHE_MaxLineVoltage 34000V → 31000V

Line Current Limit corrected
Following parameters Line Current Limit changed:
FQC_IL_Lim_VBrk4 35600V→31600
With this setting the max current is reduced between 29000V and 31600V from the maximum (= -1400A) until zero at 31600, this results to ~25% at 31000V where the loco is switched off.

Registration prevented for overflow
After a serious power module fault the drive is permanently locked, fault handling and registration are inhibited.

7.18.3 Date of issue: -
21.03.2013

7.19 Software version: -
315-344
7.19.1 Revised Nomenclature of software: -
4 13 T 03 BH
7.19.2 Details of the modification :-
- Motor temperature faults changed from bogie control to axle control.
- Speed sensor faults changed from bogie control to axle control.
- Soft crowbar functionality improved.
- CT faults detection and module isolation instead of entire bogie.
- Scaling of transformer oil pressure corrected.
- DC link short circuit detection added.
- Timeout for ASC/NSC increased to prevent pulsing stopped faults/messages.
- Motor cable snapping detection included.

7.19.3 Date of issue :-
08.04.2013 to 05.07.2013

7.20 Software version :-
345

7.20.1 Revised Nomenclature of software:-
4 13 T 04 BH

7.20.2 Details of the modification :-
- Fault filter added to prevent locking of converter in case of Usid_low fault in all the modules.
- Modification for DCU2 and DCU3 to control motors 6 and 4 in traction converter-2.

7.20.3 Date of issue :-
17.07.2013

7.21 Software version :-
346

7.21.1 Revised Nomenclature of software:-
4 13 T 05 BH

7.21.2 Details of the modification :-
- The settings of the fault groups are modified to prevent for locking at power module faults.
- The reset time for PM-faults is modified to 11 seconds. The max number of fault counts of PM-faults is decreased from 3 to 2.

7.21.3 Date of issue :-
03.09.2013
7.22  **Software version:**
347

7.22.1  **Revised Nomenclature of software:**
4 13 T 06 BH

7.22.2  **Details of the modification:**
To reset stored faults without a SCARP-Dongle, fixation hierarchy changed to customer level from strukton.

7.22.3  **Date of issue:**
19.09.2013

---

7.23  **Software version:**
348

7.23.1  **Revised Nomenclature of software:**
4 13 T 07 BH

7.23.2  **Details of the modification:**
Parameter change to turn on internal cubicle ventilation at lower temperature (permanently)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Old Value</th>
<th>New Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>TempIntFanOn</td>
<td>60°C</td>
<td>20°C</td>
</tr>
</tbody>
</table>

**Fault Handling setting for soft crowbar faults modified**
Auto reset inhibit is set for the MOK-faults of 15A5 leg1, causing the FH to lock after just one soft crowbar MOK fault. This is changed such that the MOK faults of the soft crowbar will be reset.

7.23.3  **Date of issue:**
08.11.2013

---

7.24  **Software version:**
349-350

7.24.1  **Revised Nomenclature of software:**
4 13 T 08 BH

7.24.2  **Details of the modification:**
**CT Failures are now compensated in the DSP**
In case that there is a single CT Failure (only one Current Transformer defect) this will be compensated in the inverters. The current of the missing phase is calculated out of the other two phases. The currents in the FQC will not be compensated.
Pulse test for commissioning engineers
When VCB is open and the pantograph is down and when the DC-link voltage is below 50V IGBT-pulsing can be forced with a new fixation: EnablePulseTest_Fix. This enables to check the status of all the modules without actually powering the loco.

Automatic wheel diameter correction is repaired
The automatic wheel diameter correction algorithm is corrected.

7.24.3 Date of issue :-
05.12.2013

7.25 Software version :-
351-352
7.25.1 Revised Nomenclature of software:-
4 13 T 09 BH
7.25.2 Details of the modification :-
Wheel diameter correction parameters modified.
Modification in fault table with respect to CT failures.
7.25.3 Date of issue :-
12.12.2013

7.26 Software version :-
353
7.26.1 Revised Nomenclature of software:-
4 13 T 10 BH
7.26.2 Details of the modification :-
Removed bug lifesign fault VIU - DCU
7.26.3 Date of issue :-
17.12.2013

7.27 Software version :-
354
7.27.1 Revised Nomenclature of software:-
4 13 T 11 BH
7.27.2 Details of the modification :-
• The DDS-messages which are sent to the FLG/VCU were sometimes not received by the FLG/VCU. This problem arises when the DDS-message is
sent to the FLG/VCU just after start-up. The Treset in the SLG, originally on 375 (in ticks of 16ms = 6 sec) is now increased to 625 (=10sec).
• This allows the FLG/VCU to start without missing the DDS-messages.

7.27.3 Date of issue :-
19.12.2013

7.28 Software version :-
355
7.28.1 Revised Nomenclature of software:-
4 13 T 12 BH
7.28.2 Details of the modification :-
WAG9 SType 1 added, (Loco 31248)
WAG9 SType 1 added to release (3xx.01-version).
WAG9H parameter PA09-P0905-GWZBK1CoCo increased
Parameter for max torque for loco type WAG9H was the same as for WAG9, this is not correct. Parameter is increased from 4.6 to 5.1.

7.28.3 Date of issue :-
23.12.2013

7.29 Software version :-
356
7.29.1 Revised Nomenclature of software:-
4 14 T 13 BH
7.29.2 Details of the modification :-
DSP CT failure instead of inverter offset
• The inverter offset faults (old setting 25A) which was switching off the inverter is now used for detecting of a faulty CT, setting is increased to 1000A, the inverter is not switched-off, is used in the fault table to detect a CT-failure.
• Faults and events texts corrected. Fault ticks modified.
Soft crowbar isolation added
• All soft crowbar related faults which were tripping the inverter/FQC/LS, are now coupled to BIT 7 (7-off) of the fault table, and are leading to FH_DSP_Locked_BC.
• This signal is lead to the SLG, from where it is sent to the VCU via:
• Front-end messages F0206P2 SCR-BOGIE1 ISOLATED / F0306P2 SCR-BOGIE2 ISOLATED and
• Background-messages (DDS), SLG1:0042 Disturbance SCR1 / SLG2:0042 Disturbance SCR2
• Together with the added soft crowbar isolation, consequential messages, such as discharge failure, are suppressed.
• Also node-stepping of the SLG/FLG is not blocked at a SCR-isolation.

**Defective DCU2**

When a DCU2 fails, the Bogie will not be isolated as it was in the past. The earth-voltage measurement however is not functional anymore, and earth-fault messages are now suppressed in case of a failing DCU2.

**Two DCU’s defective (DCU1/3 and DCU2)**

When DCU1 or DCU3 and DCU2 are defective, it is still possible to drive with the resulting inverter and FQC. However the loco-pilot did not get a message of the reduced performance. This is now corrected with this release.

7.29.3 **Date of issue** :-
14.01.2014

7.30 **Software version** :-
357

7.30.1 **Revised Nomenclature of software** :-
4 14 T 14 BH

7.30.2 **Details of the modification** :-
PMI software version test points set to customer
• All software version test points of the PMI’s were Strukton, changed now to customer.
• Version information is now available without SCARP-dongle

**SCR Frontend message and DDS when DCU1 or DCU3 reports life sign fault DCU2**

• When the SCR fails, a frontend message is sent to the driver, together with a DDS.
• Now these messages are also generated when the DCU2 fails.

7.30.3 **Date of issue** :-
20.04.2014

7.31 **Software version** :-
358-359

7.31.1 **Revised Nomenclature of software** :-
4 14 T 15 BH
### 7.31.2 Details of the modification :-
DiDt counter added in PMI firmware and readout in DSP-code for Earth Fault detection
- In the PMI firmware a didt counter is added to detect a high frequent component in the current of the IGBT’s which occur when there is an earth failure on one of the phase outputs. DICT and earth faults added in the fault handling but not enabled.
- Proper distribution of wheel diameter correction factors.

### 7.31.3 Date of issue :-
20.05.2014 to 11.06.2014

### 7.32 Software version :-
360-361

#### 7.32.1 Revised Nomenclature of software:-
4 14 T 16 BH

#### 7.32.2 Details of the modification :-
- Registration module moved from IRQ2 to IRQ1 to reduce processor load
- Status Error Pulse Length (SEPL) registration re-installed
- Earth fault Di/Dt-counter in PMI enabled
- Parameter FH_EnableInSimMode modified for testing in simulation mode

### 7.32.3 Date of issue :-
24.06.2014 to 01.07.2014

### 7.33 Software version :-
362

#### 7.33.1 Revised Nomenclature of software:-
4 14 T 17 BH

#### 7.33.2 Details of the modification :-
- Status errors auto-reset re-applied and no definitive lock on status errors.
- SLG Co-Co/Bo-Bo functionality re-installed (for WAP-5).
- Speed-start behavior of the inverters improved.
- Drive control leading axle trailing axle adaptation modified for BoBo (for WAP-5).

### 7.33.3 Date of issue :-
22.08.2014
7.34  Software version :-
363
7.34.1 Revised Nomenclature of software:-
4 14 T 18 BH
7.34.2 Details of the modification :-
   Bug fix of fault introduced with WAP-5 modification
   • In the release 362 WAP-5 was introduced and with this modification an error in the speed signals to the SLG was introduced for the speed coming from the DCU3. Because of this fault the wheel diameter of axle3 (TRC1) and axle4 (TRC2) were incorrect.
   • This resulted in incorrect wheel diameter correction factors for these axles and therefore in an incorrect synthetic axle calculation.
7.34.3 Date of issue :-
07.10.2014

7.35  Software version :-
365
7.35.1 Revised Nomenclature of software:-
4 14 T 19 BH
7.35.2 Details of the modification :-
   • Motor Parameter changes for loco type WAP5 with motor type 6 FXA 7059.
   • Parameters changes for loco type WAP5 for torque curves.
   • Parameters changes for loco type WAP5 for maximum allowed motor speed.
   • Parameters changes for loco type WAP5 for maximum acceleration in synthetic speed calculation.
7.35.3 Date of issue :-
10.12.2014

7.36  Software version :-
366
7.36.1 Revised Nomenclature of software:-
4 15 T 20 BH
7.36.2 Details of the modification :-
   Parameter changes to prevent for ASC stopped pulsing
   • TON_PressCoolOK: 8 → 20
   • TOFF_PressCoolOK: 5 → 10
7.36.3 Date of issue: -
24.02.2015

7.37 Software version: -
367

7.37.1 Revised Nomenclature of software: -
4 15 T 21 BH

7.37.2 Details of the modification: -

SCARP Message changes for WAP5 Loco

<table>
<thead>
<tr>
<th>Board</th>
<th>Old Text</th>
<th>New Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCU2</td>
<td>Motor1</td>
<td>Motor1</td>
</tr>
<tr>
<td>DCU1</td>
<td>Motor2</td>
<td>Motor2</td>
</tr>
<tr>
<td>DCU3</td>
<td>Motor3(Not connected)</td>
<td>NOT CONNECTED</td>
</tr>
<tr>
<td>DCU4</td>
<td>Motor4(Not connected)</td>
<td>NOT CONNECTED</td>
</tr>
<tr>
<td>DCU5</td>
<td>Motor5</td>
<td>Motor3</td>
</tr>
<tr>
<td>DCU6</td>
<td>Motor6</td>
<td>Motor4</td>
</tr>
</tbody>
</table>

7.37.3 Date of issue: -
13.07.2015

7.38 Software version: -
368

7.38.1 Revised Nomenclature of software: -
4 15 T 22 BH

7.38.2 Details of the modification: -

Tuning of temperature limits

- Temperature limits for reducing the Tr/Br-effort were hard-coded previously, namely 64°C and 66°C.

The following changes are made:
PA09_P0902_LRBTmpOISR 0.64 → 0.83 (64°C → 83°C)
PA09_P0902_LRETmpOISR 0.66 → 0.85 (66°C → 85°C)
• The temperature limit for switching off the VCB was also hard coded, namely 80°C.

PA09_P0902_GWTmpOeISR0.8 → 0.9(80°C → 90°C)

7.38.3 Date of issue:
21.08.2015

7.39 Software version:
369

7.39.1 Revised Nomenclature of software:
4 15 T 23 BH

7.39.2 Details of the modification:

Increase diff setting for FQC and INV

• The parameters for detection of current differences of FQC and Inverter are modified

FQC_I_Diff_Max:20 → 50

INV_I_Diff_Max:25 → 50

DC-link short circuit protection setting modified

• The parameters for detection of a short circuit in the DC-link are modified

DClk_SSP_Umax:1200 → 1600

DClk_SSP_Umin:200 → 1000

Fault handling ticks for BCtmax detection modified

• The ticks for the BCtmax detection (non-interrupted current in the soft-crowbar for more than 100ms) are modified.
• Old setting was such that in the event of a BCtmax the soft crowbar was switched off.
• New setting results in a Bogie-isolation

7.39.3 Date of issue:
01.10.2015
7.40  **Software version :-**
370

7.40.1  **Revised Nomenclature of software:-**
4 16 T 24 BH

7.40.2  **Details of the modification :-**

Voltage break detection improved

TOFF_PressCoolOK modified

- After panto bounce sometimes the DDS-message ASCx pulsing stopped was generated.
- To avoid this message, the parameter TOFF_PressCoolOK is increased from 10sec to 20sec.

**NB_MC changed for WAP5 from 3 to 2**

The number of motor converters for the WAP5 (Bo-Bo) is two instead of three.

7.40.3  **Date of issue :-**
19.02.2016

7.41  **Software version :-**
371

7.41.1  **Revised Nomenclature of software:-**
4 16 T 25 BH

7.41.2  **Details of the modification :-**

Tuning off time out for ASC pulsing stopped and not started

- PA08_P0845_TTimeOut_AscPSt 150[Ticks](ASCpulsingstopped)
- PA08_P0845_TTimeOut_AscPNst 15[Ticks](ASCpulsingnotstarted)

Value 150 corresponds to 15 sec

7.41.3  **Date of issue :-**
16.05.2016
(D) IGBT BASE TRACTION CONVERTER SOFTWARE SUMMARY OF M/s MEDHA

7.42 Software version :-
   1.01 - 1.03

7.42.1 Revised Nomenclature of software:-
   4 13 T 00 MD

7.42.2 Details of the modification: -
   Software versions changed during First loco commissioning at CLW.

7.42.3 Date of issue :-
   June 2013

7.43 Software version :-
   1.04

7.43.1 Revised Nomenclature of software:-
   4 14 T 01 MD

7.43.2 Details of the modification: -
   Software Tuned for Pantograph Bouncing issues.

7.43.2 Date of issue :-
   May 2014
CHAPTER - 8
MODIFICATION IN SOFTWARE OF IGBT AUXILIARY CONVERTERS

(A) IGBT BASE AUXILIARY CONVERTER SOFTWARE SUMMARY OF M/s ABB

8.1 Software version :-
10081
8.1.1 Revised Nomenclature of software:-
4 13 A 00 AB
8.1.2 Details of the modification:-
First software release for the serial production locomotive based on prototype field trial.
8.1.3 Date of issue :-
28.06.2013

8.2 Software version :-
10082
8.2.1 Revised Nomenclature of software:-
4 13 A 01 AB
8.2.2 Details of the modification: -
BUR Ventilation level modified as per CLW input
- BUR2 Frequency : 50 Hz ; When ALL BUR healthy.
- BUR2 Frequency : 50 Hz ; When BUR-3 Fail.
- BUR2 Frequency : Follow Ventilation level ; When BUR-1 Fail.
8.2.3 Date of issue :-
25.07.2013

8.3 Software version :-
10083
8.3.1 Revised Nomenclature of software:-
4 14 A 02 AB
8.3.2 Details of the modification: -
- Implemented the ventilation level-3 either with 50 Hz or 44 Hz by selecting the digital input for two different type of Oil Cooling Unit
- Battery voltage signal added in the BUR software to transfer to the Vehicle Control Unit.
8.3.3 Date of issue :-
04.11.2014

Prepared by

Checked by

Issued by
8.4 Software version :-
10084
8.4.1 Revised Nomenclature of software:-
4 14 A 03 AB
8.4.2 Details of the modification: -
File management system to store the TR files has been upgraded to avoid the failure of flash memory data which cause the software corruption.
8.4.3 Date of issue:-
14.05.2014

8.5 Software version :-
10085
8.5.1 Revised Nomenclature of software:-
4 15 A 04 AB
8.5.2 Details of the modification: -
• DDS logic along with environment data has been updated in the software.
• Improved the updating rate of the CAN telegrams, so ventilation feedback is provided by the Auxiliary converter to the VCU/Traction Converter.
8.5.3 Date of issue :-
13.08.2015

8.6 Software version :-
10086
8.6.1 Revised Nomenclature of software:-
4 15 A 04 AB
8.6.2 Details of the modification: -
• DDS Logic for indirect operating contactor (Q41_52 & Q42_51) stuck on/off has been improved.
• MVB Failure tripping delay increased to 3second to improve the FLG redundancy.
8.6.3 Date of issue :-
27.05.2016
(B) IGBT BASE AUXILIARY CONVERTER SOFTWARE SUMMARY OF M/s BHEL

8.7 Software version :-
169.4
8.7.1 Revised Nomenclature of software: -
4 11 A 00 BH
8.7.2 Details of the modification: -
ACI-DSP:
- Redundancy frequency value BUR1 changed from 50 Hz to 37.99 Hz
- Redundancy frequency value BUR2 changed from 47 Hz to 37.99 Hz
- Database parameter PA76_P7601_FreqLv13A changed from 50 Hz to 37.01 Hz
8.7.3 Date of issue :-
10.10.2011

8.8 Software version :-
170
8.8.1 Revised Nomenclature of software: -
4 11 A 01 BH
8.8.2 Details of the modification: -
- Add test points for processor load in DSP of ACI, CREC, LVPA and ACPS.
- Registration block updated.
- Added variables for registration during fault.
- ARM firmware changed from 1.05 to 1.06.
8.8.3 Date of issue :-
10.10.2011

8.9 Software version :-
171
8.9.1 Revised Nomenclature of software: -
4 12 A 02 BH
8.9.2 Details of the modification: -
Upgrade DSP code ACI
- Correction off addresses registration module
- Registrations added:
  Lifesign fault AMC1 (fault 32)
  Lifesign fault AMC2 (fault 33) Lifesign fault AMC3 (fault 34)
Lifesign fault 60ms process (fault 35)  
ACI started  
Upgrade DSP code AMC2

- Registration added  
  AMC2 started

Upgrade DSP code AMC3

- Registration added  
  AMC3 started  
  Registration signals changed  
  Full-scale values of registration signals re-defined

8.9.3 Date of issue :-  
12.03.2012

8.10 Software version :-  
171.1

8.10.1 Revised Nomenclature of software:-  
4 12 A 03 BH

8.10.2 Details of the modification:-  
Upgrade parameter on CREC

- c_1224_Uac_in_rms_max1  1650 → 1200  
- c_1225_Uac_in_rms_max2  1720 → 1240

Upgrade FPGA on ACPS

- Max_heatsinklimit from 80C to 90C

8.10.3 Date of issue :-  
16.05.2012

8.11 Software version :-  
173

8.11.1 Revised Nomenclature of software:-  
4 12 A 04 BH

8.11.2 Details of the modification:-  
Upgrade DSP software ACPS

- Improved RMS calculation to measure values at other frequencies than 50 Hz also accurate
- Added of fixation to reset fault handling.
- Added fixation control IR compensation.

Parameter change:
- `i_1122_SHORT_TIME_CURRENT_I` from 300 to 360 A (According specification 130 kVA inverter).

8.11.3 Date of issue:--
16.05.2012

8.12 Software version:--
174

8.12.1 Revised Nomenclature of software:--
4 12 A 05 BH

8.12.2 Details of the modification:--
Upgrade DSP software CREC
- All variables and fixations set to customer, so without SCARP Dongle variables and fixations can be monitored and changed.

Setting change:
- `C_1017_CREC_standalone` from par fix. → RT of SPARC-01b and SPARC-02b can be used without dongle.

Setting change:
- The signal `b_1076_LifeSignACI_DSP_OK` will be set to 1 if the module is in stand-alone mode only for test purposes.

8.12.3 Date of issue:--
16.05.2012

8.13 Software version:--
174.3

8.13.1 Revised Nomenclature of software:--
4 12 A 06 BH

8.13.2 Details of the modification:--
Parameter setting ACI
- Parameter `PA00_P000_DiagReset` has been set from 16 to 300 (5 minutes) to avoid disturbance at startup and to prevent “Battery too low” error.
ARM Firmware

- "Reset source identification" bits available for ICP-DSP investigation reset ACI boards BHEL CLW E-Loc).
- lifesignWDFeed function ACI boards available for AMC-DSP (investigation reset ACI boards BHEL CLW E-Loc).
- Show result and freshness counter of data port 3010 when replier status not OK (for debug purposes).
- Improved DHCP re-initialization.
- Battery backed up RTC, in combination with a RTC 32 kHz oscillator, is now supported.

8.13.3 Date of issue :-
26.08.2012

8.14 Software version :-
181.2

8.14.1 Revised Nomenclature of software:-
4 12 A 07 BH

8.14.2 Details of the modification: -
General
- Improved fault handling implemented (suppress fault handling when starting up). Now at startup no disturbance is coming.
- Registration block defines changed to make longer registrations.

ACIDSP code

- Separate parameter PA00_P0000_BatMonDelay for monitoring battery voltage and current. This parameter has a value of 32 (19.2 seconds) to prevent a “Battery too low” error at startup.
- PA01_P0103_M100_OK_Off_Delay parameter introduced to prevent MCB.
- battery charger fault when switching off AUX2 electronics. Default value of this parameter is 7 (420 ms).
LVPSa DSP code

- Reset pulse from 1 ms to 150 ms (Reset Protection).

ACPS DSP code

- 4.2 V-Hz Control: Determination minimum reference frequency inverter modified. A possible solution for speed start ACPS has been implemented. Through parameter EnableFanSpdEstRampup this solution can be enabled or disabled (default is disabled).

8.14.3 Date of issue: -
04.09.2012

8.15 Software version: -
182.0

8.15.1 Revised Nomenclature of software:-
4 12 A 08 BH

8.15.2 Details of the modification: -
LVPSa DSP code

- An ACI lifesign fault and unique number check for release of AMC1 can be ignored with parameter Ignore LifesignACI_AMCEqual (default is ignored).
- Lifesign error fault of the ACI causing the FH to lock has now been disabled.

8.15.3 Date of issue: -
08.09.2012

8.16 Software version: -
182.1

8.16.1 Revised Nomenclature of software:-
4 12 A 09 BH

8.16.2 Details of the modification: -
ACIDSP code

- Software version BUR available on MVB.

8.16.3 Date of issue: -
8.17 Software version :-
182.2-183

8.17.1 Revised Nomenclature of software:-
4 13 A 10 BH

8.17.2 Details of the modification:-
ACIARM Firmware V1.12: (D2000 configV25.0.0)
- Redundancy DDS messages.
- Added replier function IDs for messages to VCU1.
LVPSa:
    The
    signals “faulthandlinglocked” and “faulthandlingstop” are now passed to
    the ACI
ACI:
- Added fixations for debugging battery voltage levels.
- A priority 2 message and DDS will be reported when the fault handling
  module on the battery charger is locked for more than 30 seconds.

8.17.3 Date of issue :-
11.01.2013

8.18 Software version :-
183.1

8.18.1 Revised Nomenclature of software:-
4 14 A 11 BH

8.18.2 Details of the modification: -
LineVoltageOOR:
Line voltage out of range registration added

8.18.3 Date of issue :-
23.04.2014

8.19 Software version :-
983.2

8.19.1 Revised Nomenclature of software:-
4 14 A 12 BH
8.19.2 Details of the modification: -
FPGA settings modified ACPS over temperature:

- HS_TEMP_MAX from 90 → 95°C
- HS_TEMP_MAX_START from 88 → 93°C

8.19.3 Date of issue: -
23.04.2014

8.20 Software version: -
983.3

8.20.1 Revised Nomenclature of software: -
4 15 A 13 BH

8.20.2 Details of the modification: -
FPGAImageVersion 0.05:
- Test version Bug fix to prevent startup in safe mode due to simultaneously read/write.

8.20.3 Date of issue: -
06.02.2015

8.21 Software version: -
984.0

8.21.1 Revised Nomenclature of software: -
4 15 A 14 BH

8.21.2 Details of the modification: -
- ACPS, speed start functionality:
- ACI, Battery charger message F0903P2 implementation in BUR2:
- ACI, modified parameter:
- PA00_P0000_BatMonDelay, old value 32, new value 130

8.21.3 Date of issue: -
21.04.2015

8.22 Software version: -
985.0

8.22.1 Revised Nomenclature of software: -
4 15 A 15 BH

8.22.2 Details of the modification: -
- ACPS, speed start functionality modified and CREC Ucmax modified.
- ACPS, output protection added (Loose connection / IGBT not switching).

**8.22.3 Date of issue** :
19.06.2015

**8.23 Software version** :
985.5

**8.23.1 Revised Nomenclature of software** :
4 15 A 16 BH

**8.23.2 Details of the modification** :
- Parameter changes for ACPS:
  - SS_CURRENTREFHIGH to 300A.
  - SS_CURRENTREFLOW to 300A.
  - INV_ACCTIME from 20 to 10 sec.

**8.23.3 Date of issue** :
19.06.2015

**8.24 Software version** :
186.0

**8.24.1 Revised Nomenclature of software** :
4 16 A 17 BH

**8.24.2 Details of the modification** :
This software version has no modifications, it an official release instead of fastest release 985.5.

**8.24.3 Date of issue** :
04.01.2016

**8.25 Software version** :
187.0

**8.25.1 Revised Nomenclature of software** :
4 16 A 18 BH

**8.25.2 Details of the modification** :
- ACI, BUR3 Battery charger message F903P2 made analogue to BUR2.
- ACI, time for F903P2 message changed from 10 minutes to 1 minute.
- ACI, F903P2 message inhibited in simulation mode.
- Fault handling ticks removed from locking Auxiliary.

**8.25.3 Date of issue** :
19.02.2016
(C) IGBT BASE AUXILIARY CONVERTER SOFTWARE SUMMARY OF M/s MEDHA

8.26 Software version :-
2.01 – 2.06
8.26.1 Revised Nomenclature of software:-
4 16 A 00 MD
8.26.2 Details of the modification: -
Software versions changed during First loco commissioning at CLW.
8.26.3 Date of issue :-
In Year 2016

8.27 Software version :-
2.07
8.27.1 Revised Nomenclature of software:-
4 16 A 01 MD
8.27.2 Details of the modification: -
Software Modified as per ELS/TATA Suggestions vide letter RS/TATA/T/3Ph Medha/710.
8.27.3 Date of issue :-
25-04-2016
(D) IGBT BASE AUXILIARY CONVERTER SOFTWARE SUMMARY OF M/s HIRECT

8.28 Software version :-
V31_39_02_33
8.28.1 Revised Nomenclature of software:-
4 16 A 00 HR
8.28.2 Details of the modification: -
For Inverter Control
  • BUR2 Ramp down time changed from 15 Sec to 9 second to avoid intermittent tripping of BUR2 during transition from Vent. Level 3 to Vent. Level 2.
8.28.3 Date of issue :-
08-01-2015

8.29 Software version :-
V1.01
8.29.1 Revised Nomenclature of software:-
4 16 A 01 HR
8.29.2 Details of the modification: -
For MVB Message Data
  • DDS Message Data Implementation
8.29.3 Date of issue :-
11-08-2016

8.30 Software version :-
V31_38_02_38
8.30.1 Revised Nomenclature of software:-
4 16 A 02 HR
8.30.2 Details of the modification:
-For CCU_SCR Control
  • To avoid BUR isolation in case of FLG1 isolation, Modification for All BUR for modified logic to release life sign signal with life sign either from FLG1 or FLG2.
8.30.3 Date of issue :-
24-08-2016