



Bharat Heavy Electricals Limited
(A Government of India undertaking)
Electronics Division
PB 2606, Mysore Road Bangalore, 560026 INDIA

Fx : 0091 80 26989217

☎ : 0091 80 26989210

To
Deputy Chief Electrical Engineer
Design and Development Center
Chittaranjan Locomotive Works
Chittaranjan. WB

Ref : 445/rs/clw_sw_apprvl/19
Date : 10th Sep'2019

Dear Sir,

Kind Attn: Sri. RP Bharti

Sub: Application Software of three phase drive propulsion equipment (SR, BUR, VCU & DDU) for hosting webpage on CLW website – Regarding approval

Ref: CLW Email Dated 6th Aug'2019 and discussion in the office of CEE/D & D on 12th Aug'2019

This has reference to our discussion on the application software to be handed over to CLW / D & D for uploading on CLW website.

As discussed the current versions of software that are in use are given below for ready reference

SI No	Equipment	Current Software Version
1	IGBT Based Traction Converter	774
2	3 X 130 KVA Auxiliary Converter	188.1
3	BHEL Make TCN Based VCU	49

Based on the field performance requirement and loco shed feedback, we have reviewed the software and updated to address the same. Updated versions were validated in the lab. The updated versions are given below for ready reference

SI No	Equipment	Updated Software Version
1	IGBT Based Traction Converter	786
2	3 X 130 KVA Auxiliary Converter	188.2
3	BHEL Make TCN Based VCU	50

The release notes for the above software are enclosed for ready reference which details the changes made against version.

Request you to kindly accord approval for the updated versions so as to enable us share the software with all the loco sheds

Thanking you,

Yours faithfully

Shekar R
AGM/TE

Traction Converter Software Release Note Details

Release no.	Software optimisation
312 (07-01-2013)	<p><u>Line voltage measurement</u> During simulation mode the pantograph is down. In situations that the catenary is earthed, the voltage on the pantograph is 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 behaviour 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</p> <p><u>Panto Bounce detection</u> 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.</p>
313 (02-03-2013)	<p><u>Line Current Limit corrected</u> Following parameters Line Current Limit changed: FQC_IL_Lim_Pos 2666A →1400A FQC_IL_Lim_Neg -2666A →-1400A</p> <p><u>Not used Fault handling signals removed</u> 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)</p>
314 (21-03-2013)	<p><u>Max line voltage reduced</u> Following parameter changed: OHE_MaxLineVoltage 34000V → 31000V</p> <p><u>Line Current Limit corrected</u> 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</p> <p><u>Registration prevented for overflow</u> After a serious power module fault the drive is permanently locked, fault handling and registration are inhibited</p>
315 – 344 (08-042013 to 05-07-2013)	<p>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</p>
345 (17-07-2013)	<p>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</p>
346 (03-09-2013)	<p>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</p>

	PM-faults is decreased from 3 to 2.						
347 (19-09-2013)	To reset stored faults without a SCARP-Dongle, fixation hierarchy changed to customer level from strukton						
348 (08-11-2013)	<p>Parameter change to turn on internal cubicle ventilation at lower temperature (permanently)</p> <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> <p>Fault Handling setting for soft crowbar faults modified</p> <p>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.</p>	Parameter	old value	new value	TempIntFanOn	60°C	20°C
Parameter	old value	new value					
TempIntFanOn	60°C	20°C					
349-350 (05-12-2013)	<p><u>CT Failures are now compensated in the DSP</u></p> <p>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.</p> <p><u>Pulse test for commissioning engineers</u></p> <p>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</p> <p><u>Automatic wheel diameter correction is repaired</u></p> <p>The automatic wheel diameter correction algorithm is corrected</p>						
351-352 (12-12-2013)	<p>Wheel diameter correction parameters modified</p> <p>Modification in fault table with respect to CT failures</p>						
353 (17-12-2013)	Removed bug lifesign fault VIU - DCU						
354 (19-12-2013)	<p>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).</p> <p>This allows the FLG/VCU to start without missing the DDS-messages</p>						
355 (23-12-2013)	<p><u>WAG9 SPtype 1 added, (Loco 31248)</u></p> <p>WAG9 SPtype 1 added to release (3xx.01-version)</p> <p><u>WAG9H parameter PA09-P0905-GWZBK1CoCo increased</u></p> <p>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</p>						
356 (14-01-2014)	<u>DSP CT failure instead of inverter offset</u>						

	<p>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.</p> <p>Faults and events texts corrected. Fault ticks modified</p> <p><u>Soft crowbar isolation added</u></p> <p>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.</p> <p>This signal is lead to the SLG, from where it is sent to the VCU via:</p> <p>Front-end messages F0206P2 SCR-BOGIE1 ISOLATED / F0306P2 SCR-BOGIE2 ISOLATED and</p> <p>Background-messages (DDS), SLG1:0042 Disturbance SCR1 / SLG2:0042 Disturbance SCR2</p> <p>Together with the added soft crowbar isolation, consequential messages, such as discharge failure, are suppressed.</p> <p>Also node-stepping of the SLG/FLG is not blocked at a SCR-isolation.</p> <p><u>Defective DCU2</u></p> <p>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</p> <p><u>Two DCU's defective (DCU1/3 and DCU2)</u></p> <p>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.</p>
<p>357 (20-04-2014)</p>	<p><u>PMI software version test points set to customer</u></p> <p>All software version test points of the PMI's were Strukton, changed now to customer.</p> <p>Version information is now available without SCARP-dongle</p> <p><u>SCR Frontend message and DDS when DCU1 or DCU3 reports lifesign fault DCU2</u></p> <p>When the SCR fails, a frontend message is sent to the driver, together with a DDS.</p> <p>Now these messages are also generated when the DCU2 fails</p>
<p>358-359 (22-05-2014 to 11-06-2014)</p>	<p><u>DiDt counter added in PMI firmware and readout in DSP-code for Earth Fault detection</u></p> <p>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.</p> <p>Proper distribution of wheel diameter correction factors</p>
<p>360-361 (24-06-2014 to</p>	<p>Registration module moved from IRQ2 to IRQ1 to reduce processor load</p>

01-07-2014)	<p>Status Error Pulse Length (SEPL) registration re-installed</p> <p>Earth fault Di/Dt-counter in PMI enabled</p> <p>Parameter FH_EnableInSimMode modified for testing in simulation mode</p>																					
362 (22-08-2014)	<p>Status errors auto-reset re-applied and no definitive lock on status errors</p> <p>SLG CoCo/BoBo functionality re-installed (for WAP-5)</p> <p>Speed-start behavior of the inverters improved</p> <p>Drive control leading axle trailing axle adaptation modified for BoBo (for WAP-5)</p>																					
363 (07-10-2014)	<p><u>Bug fix of fault introduced with WAP-5 modification</u></p> <p>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.</p> <p>This resulted in incorrect wheel diameter correction factors for these axles and therefore in an incorrect synthetic axle calculation.</p>																					
365 (10-12-2014)	<p>Motor Parameter changes for loco type WAP5 with motor type 6 FXA 7059</p> <p>Parameters changes for loco type WAP5 for torque curves</p> <p>Parameters changes for loco type WAP5 for maximum allowed motor speed</p> <p>Parameters changes for loco type WAP5 for maximum acceleration in synthetic speed calculation</p>																					
366 (24-02-2015)	<p>Parameter changes to prevent for ASC stopped pulsing</p> <ul style="list-style-type: none"> • TON_PressCoolOK: 8 → 20 • TOFF_PressCoolOK: 5 → 10 																					
367 (13-07-2015)	<p><u>SCARP Message changes for WAP5 Loco</u></p> <table border="1" data-bbox="505 1371 1308 1833"> <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>	Board	Old Text	New Text	DCU2	Motor1	Motor1	DCU1	Motor2	Motor2	DCU3	Motor3 (Not connected)	NOT CONNECTED	DCU4	Motor4 (Not connected)	NOT CONNECTED	DCU5	Motor5	Motor3	DCU6	Motor6	Motor4
Board	Old Text	New Text																				
DCU2	Motor1	Motor1																				
DCU1	Motor2	Motor2																				
DCU3	Motor3 (Not connected)	NOT CONNECTED																				
DCU4	Motor4 (Not connected)	NOT CONNECTED																				
DCU5	Motor5	Motor3																				
DCU6	Motor6	Motor4																				
368 (21-08-2015)	<p><u>Tuning of temperature limits</u></p>																					

	<p>Temperature limits for reducing the Tr/Br-effort were hard-coded previously, namely 64°C and 66°C.</p> <p>The following changes are made:</p> <p>PA09_P0902_LRBTmpOISR 0.64 → 0.83 (64°C → 83°C)</p> <p>PA09_P0902_LRETmpOISR 0.66 → 0.85 (66°C → 85°C)</p> <p>The temperature limit for switching off the VCB was also hard coded, namely 80°C</p> <p>PA09_P0902_GWTmpOeISR 0.8 → 0.9 (80°C → 90°C)</p>
<p>369 (01-10-2015)</p>	<p><u>Increase Idiff setting for FQC and INV</u></p> <p>The parameters for detection of current differences of FQC and Inverter are modified</p> <p>FQC_I_Diff_Max: 20→50</p> <p>INV_I_Diff_Max: 25→50</p> <p><u>DC-link short circuit protection setting modified</u></p> <p>The parameters for detection of a short circuit in the DC-link are modified</p> <p>DCLink_SSP_Umax: 1200→1600</p> <p>DCLink_SSP_Umin: 200→1000</p> <p><u>Fault handling ticks forBCtmax detection modified</u></p> <p>The ticks for the BCtmax detection (non-interrupted current in the soft-crowbar for more than 100ms) are modified.</p> <p>Old setting was such that in the event of a BCtmax the soft crowbar was switched off.</p> <p>New setting results in a Bogie-isolation</p>
<p>370 (19-02-2016)</p>	<p><u>Voltage break detection improved</u></p> <p><u>TOFF PressCoolOK modified</u></p> <p>After panto bounce sometimes the DDS-message ASCx pulsing stopped was generated.</p> <p>To avoid this message,the parameter TOFF_PressCoolOK is increased from 10sec to 20sec</p> <p><u>NB MC changed for WAP5 from 3 to 2</u></p> <p>The number of motor converters for the WAP5 (BoBo) is two instead of three</p>
<p>371 (16-05-2016)</p>	<p><u>Tuning of time out for ASC pulsing stopped and not started</u></p>

	<p>PA08_P0845_TTimeOut_AscPSt 150 [Ticks] (ASC pulsing stopped)</p> <p>PA08_P0845_TTimeOut_AscPNst 150 [Ticks] (ASC pulsing not started)</p> <p>Value 150 corresponds to 15 sec</p>
<p>373 (23-8-2017)</p>	<p><u>Increase in Initial reset time:</u></p> <p>The start-up reset time Treset is increased from 625 (=10sec) to 2062 (=32.992sec)</p> <p><u>Increase in time for generation of filter contactor messages:</u></p> <p>Time delay for generation of Stuck on message for filter contactors 8.1 and 8.2 have been increased to 2 Sec.</p> <p>Timeout_Filt_Stkon 20 (100ms Task)</p> <p>Timeout_FiltAd_Stkon 20 (100ms Task)</p> <p><u>Registration in case of DC link Earth Faults:</u></p> <p>DCU2 Fault table has been modified to add the fault ID 75: EarthFault DC link +/- ve to make a registration.</p>
<p>774 (4-5-2018)</p>	<p><u>Increase in SEPL Max fault generation time:</u></p> <p>Parameter change: SEPL_MAX has been increased from 750 to 1000</p>
<p>786 (04-09-2019)</p>	<p><u>Note: All test versions in between have been merged and made as 786</u></p> <p>1) <u>Energy Calculation Algorithm:</u></p> <p>Energy calculation has been implemented based on the primary current rather than front end power.</p> <p>2) <u>FOC Phase angle correction during Bogie Isolation:</u></p> <p>As per the observation made by ELS/LGD, the phase angle has been corrected to reduce the harmonic current when one bogie is isolated.</p> <p>3) <u>Increase of Power output in WAP-5 locomotives:</u></p> <p>As per RDSO directive requirement vide letter EL/11.5.5/4 dtd 28.09.2018, the torque speed characteristics have been modified to deliver 6000 HP power at the wheels for WAP-5 locomotives.</p> <p>4) <u>Speed Sensor Disturbance from all motors:</u></p> <p>Control logic has been corrected to avoid speed sensor channel disturbances due to VCU reset in a running loco.</p>

5) Improvements with respect to Usid_Low and SEPL_Max:

- a) One auto reset is allowed for Usid_Low to avoid the spurious fault recordings.
- b) In case of SEPL_Max, the isolation is limited to the particular DCU and bogie is not isolated.

Auxiliary Converter Software Release Note Details

Release no.	Software Optimization
169.4 (10-10-2011)	ACI-DSP: <ul style="list-style-type: none"> ➤ 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
170 (10-10-2011)	<ul style="list-style-type: none"> ➤ 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
171 (12-03-2012)	Upgrade DSP code ACI <ul style="list-style-type: none"> ➤ 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 <ul style="list-style-type: none"> ➤ Registration added AMC2 started Upgrade DSP code AMC3 <ul style="list-style-type: none"> ➤ Registration added AMC3 started Registration signals changed Full-scale values of registration signals re-defined
171.1 (16-05-2012)	Upgrade parameter on CREC <ul style="list-style-type: none"> ➤ c_1224_Uac_in_rms_max1 1650 → 1200 ➤ c_1225_Uac_in_rms_max2 1720 → 1240 Upgrade FPGA on ACPS <ul style="list-style-type: none"> ➤ Max_heatsink limit from 80C to 90C
173 (16-05-2012)	Upgrade DSP software ACPS <ul style="list-style-type: none"> ➤ 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: <ul style="list-style-type: none"> ➤ i_1122_SHORT_TIME_CURRENT_I from 300 to 360 A (According specification 130 kVA inverter)
174 (16-05-2012)	Upgrade DSP software CREC <ul style="list-style-type: none"> ➤ All variables and fixations set to customer, so without SCARP Dongle variables and fixations can be monitored and changed Setting change: <ul style="list-style-type: none"> ➤ C_1017_CREC_standalone from par → fix. RT of SPARC-01b and SPARC-02b can be used without dongle Setting change: <ul style="list-style-type: none"> ➤ The signal b_1076_LifeSignACI_DSP_OK will be set to 1 if the module is in stand-alone mode only for test purposes.

<p>174.3 (26-08-2012)</p>	<p>Parameter setting ACI</p> <ul style="list-style-type: none"> ➤ 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 <p>ARM Firmware</p> <ul style="list-style-type: none"> ➤ "Reset source identification" bits available for ICP-DSP (investigation reset ACI boards BHEL CLW E-Loc) ➤ lifesign WDFeed 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.
<p>181.2 (04-09-2012)</p>	<p>General</p> <ul style="list-style-type: none"> ➤ 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 <p>ACI DSP code</p> <ul style="list-style-type: none"> ➤ 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). <p>LVPSa DSP code</p> <ul style="list-style-type: none"> ➤ Reset pulse from 1 ms to 150 ms (ResetProtection) <p>ACPS DSP code</p> <ul style="list-style-type: none"> ➤ 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)
<p>182.0 (08-09-2012)</p>	<p>LVPSa DSP code</p> <ul style="list-style-type: none"> ➤ An ACI lifesign fault and unique number check for release of AMC1 can be ignored with parameter IgnoreLifesignACI_AMCEqual (default is ignored) ➤ Lifesign error fault of the ACI causing the FH to lock has now been disabled
<p>182.1 (19-12-2012)</p>	<p>ACI DSP code</p> <ul style="list-style-type: none"> ➤ Software version BUR available on MVB
<p>182.2-183 (11-01-2013)</p>	<p>ACI ARM Firmware V1.12: (D2000 config V25.0.0)</p> <ul style="list-style-type: none"> ➤ Redundancy DDS messages ➤ Added replier function IDs for messages to VCU1 <p>LVPSa:</p> <p>The signals "fault handling locked" and "fault handling stop" are now passed on to the ACI</p> <p>ACI :</p> <ul style="list-style-type: none"> ➤ 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.
<p>183.1 (23-04-2014)</p>	<p>LineVoltageOOR: Line voltage out of range registration added</p>

983.2 (23-04-2014)	FPGA settings modified ACPS overtemperature: <ul style="list-style-type: none"> ➤ HS_TEMP_MAX from 90 → 95°C ➤ HS_TEMP_MAX_START from 88 → 93°C
983.3 (06-02-2015)	FPGA image Version 0.05: <ul style="list-style-type: none"> ➤ Test version Bugfix to prevent startup in safe mode due to simultaneously read/write
984.0 (21-04-2015)	<ul style="list-style-type: none"> ➤ ACPS, speed start functionality: ➤ ACI, Battery charger message F0903P2 implementation in BUR2: ➤ ACI, modified parameter: PA00_P0000_BatMonDelay, old value 32, new value 130
985.0 (19-06-2015)	<ul style="list-style-type: none"> ➤ ACPS, speed start functionality modified and CREC Ucmx modified ➤ ACPS, output protection added (Loose connection / IGBT not switching)
985.5 (19-06-2016)	Parameter changes for ACPS: <ul style="list-style-type: none"> ➤ SS_CURRENTREFHIGH to 300A ➤ SS_CURRENTREFLOW to 300A ➤ INV_ACCTIME from 20 to 10 sec
186.0 (04-01-2016)	This software version has no modifications, it an official release instead of a test release 985.5
187.0 (19-02-2016)	<ul style="list-style-type: none"> ➤ ACI, BUR3 Battery charger message F903P2 made analogue to BUR2 ➤ ACI, time forF903P2 message changed from 10 minutes to 1 minute ➤ ACI,F903P2 message inhibited in simulation mode ➤ Fault Handling ticks removed from locking Auxiliary
187.1 06-10-2016	Parameters are changed for ACPS <ul style="list-style-type: none"> ➤ Deadtime from: 2us → 3us ➤ INT_DIDT from: 2us → 3 us
187.2 3-11-2016	Previous version contained an old version of the FPGA firmware because of a SCARP issue, certain file-names are not automatically recognized and have to be manually re-named: ACI firmware: 0.03 → 0.05
887.2 07-03-2017	ACI Parameter change: Previous version contained a limit on frequency output from BUR 2 at 47 Hz through hardcoded parameter WR_FEST_WUFWR_MAX_BUR2. In this version, the parameter is made tunable and set to 0.5 which sets the BUR2 max frequency to 50Hz. AMC2 Parameter change: The maximum modulation correction factor has been changed from 1.3 to 1.38. i_1025_INV_MOD_CORR: 1.3 → 1.38
188.0 03-07-2017	Modifications made by BHEL in release 887.2 made official
188.1 13-07-2017	ACI Parameter change: PA00_P0000_Init_MVB: 10 → 54 (from 6 sec to 32 sec) PA00_P0000_DiagReset: 16 → 59 (from 9.6 sec to 35 sec)
889.1 09-02-2019	Inverter Parameter change: i_1020_INV_ACC_TIME changed from 10 → 5

889.2 19-02-2019	Upgrade DSP software of ACI When MCB 2F2 is off, ACI3 does not receive the battery voltage from AMC1 and loco shuts down immediately with Battery voltage too low To eliminate this condition battery voltage is now directly read by AMC2 of BUR-3 and signal H_FLGM_21_XU_Battery is used in BUR-3 for generation of above messages.
188.2 29-05-2019	Inverter Parameter change: OffsetCurPeNotSwitching changed from 5→20