SIEMENS

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Your letter of	
Our reference	SMO/RS/CLW/046
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Kind Attention: Shri. Pankaj Kumar (Dy.CEE/D&D/CLW/CRJ)

Sub: Request to regular approval of final CCU software ver 2.06, TCU software 2.25 & ACU2.07 package as per below mentioned details to upload in all IGBT based propulsion system 6000HP (Leroy & Lutze IO module) WAG-9 / WAP-7 fitted locomotives.

Ref: CLW letter no-C-D&D/T/24 Part-II/Siemens dated 25.06.24

Dear Sir,
With reference to the above subject matter, we wish to inform you that we did improvement in software to improving reliability of 6K propulsion system. Details of the software update mentioned in release note.

Software details of 6000 HP WAG-9/WAP-7 (Leroy & Lutze IO module) are as below.

Controller Name	Application	NSDB	Operating system	Parameter
CCU 1	2.06	2.80	2.05	0.224
CCU 2	2.06	2.80	2.05	0.224
TCU 1	2.25	2.32	2.05	
TCU 2	2.25	2.32	2.05	
WTB	3.13	2.22		
SIEMENS Display 1	1.2.0 (WAG-9) & 1.1.5 (WAP7)	2.66		
SIEMENS Display 2	1.2.0 (WAG-9) & 1.1.5 (WAP7)	2.66		
AMiT Display 1	2.1.2	2.66		
AMiT Display 2	2.1.2	2.66		
AUX1	2.07	1.67		
AUX2	2.07	1.67		
AUX3	2.07	1.67		
IO Station 11	1.05/1.22/2.00/0.21	1.00/0.002/0.01/2.00/1.02		
IO Station 12	1.05/1.22/2.00/0.52	1.00/0.002/0.01/2.00/1.02		
IO Station 21	1.05/1.22/2.00/0.21	1.00/0.002/0.01/2.00/1.02		
IO Station 22	1.05/1.22/2.00/0.52	1.00/0.002/0.01/2.00/1.02		

- **I/O station software version mentioned above. It may change depending on make and firmware. of supplied IO cards.**

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We request you to kindly provide regular approval for uploading aforesaid software in all commissioned and supplied propulsion system of 6000HP WAG-9H or WAP-7 (Leroy or Lutze IO cards) fitted locomotives to improving reliability.

Thanking you and assuring you the best of our services, we remain.

Yours faithfully,

Pandey Arvind Kumar

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Encl- Release note

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To all Team Leads and CCU System Engineers.	Issue Date.	10-Jun-2024
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Release of CCU & TCU software.

Table of Contents

1. Purpose

This document explains the process of for version management, monitoring & release of CCU, ACU, IOs and Driver Display software for Locomotives.

2. Scope

The scope of the documents is applicable for following activities.

i. CCU, IOs and DDU software release and status monitoring

ii. CCU, IOs and DDU Software version management

iii. CCU, IOs and Display Software Tag management

3. Abbreviations and Definition

CCU:	Central control Unit
DDU:	Driver Display Unit
PGM:	Program file
ACU:	Auxiliary Control Unit
IOs:	Input Output modules

4. Hardware Configurations

The device has to be fulfilled following conditions.

Device	Order Nos. / Make
CCU (MCU2)	6FH5155-
DDU	1PA2B00075622
ACUs	M1300/M2000
IOs	LUTZE LION / LEROY
DDU AMiT	APTXA003C

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5. Released Software details.

Part.	Last released: 2.05 Dt:04-Dec-2023	Version to be released: 2.06 Dt: 10- Jul -24
MCU_CCU		
- Operating System	2.05 10-May-20	2.05 10-May-20
- Hardware module	70.01, 10-May-20	70.01, 10-May-20
- ETH2-Firmware	3.1 4-Dec-20	3.1 4-Dec-20
- Communication Drivers	17.0, 29-Aug-19	17.0, 29-Aug-19
- NSDB	2.80 4-Jul-23	**2.80** **10- Jul -24**
- Program	2.05 04- Dec -23	**2.06** **10- Jul -24**
- Parameter	0.216 04-Dec-23	**0.224** **10- Jul -24**
DDU		
- Program	SIEMENS DISPLAY 1.1.8(6K)/1.1.2(WAP-7)/1.2.3(9K) 04-Dec-23 AMIT Display 2.1.1 04-Dec-23	**SIEMENS DISPLAY** **Ver: - 1.2.0(6K)** **Ver: - 1.1.5(WAP-7)** **Ver: - 1.2.5(9K)** **Dt:- 10- Jul -24** **AMIT Display** **2.1.2 10- Jul -24**
- NSDB	SIEMENS DISPLAY & AMIT Display 2.66 20-Oct-21	SIEMENS & AMIT Display 2.66 20-Oct-21
ACU		
- Program	2.06, 04-Dec-2023	**2.07, 10-Jul-24**
- NSDB	1.67	1.67
IO Station		
Lutze IO FW VER 1.05 & 1.2		
- Bus coupler Firmware	1.05/1.22	1.05/1.22
- NSDB	1.00, 0.02,0.01 and 1 respectively. 10/May/2020	1.00, 0.02,0.01 and 1 respectively. 10/May/2020
Lutze IO FW VER 2.0		
- Bus coupler Firmware	2	2
- NSDB	1.00 (11,12,21 &22), 13/Sept/2022	1.00 (11,12,21 &22), 13/Sept/2022
LEROY IO Ver		
Application	0.21 for IO Station 11 & 21 0.52 for IO Station 12 & 22	0.21 for IO Station 11 & 21 0.52 for IO Station 12 & 22
- NSDB	1.02	1.02

TCU Software Version

Part.	Last released: 2.22 Dt:04-Dec-2023	Version to be released: 2.06 Dt: 10- Jul -24
MCU_TCU		
- Operating System	2.05 01-Aug-19	2.05 01-Aug-19
- Hardware module	70.01, 12-Jun-19	70.01, 12-Jun-19
- ETH2-Firmware	3.1 4-Dec-20	3.1 4-Dec-20
- Communication Drivers	17.0, 29-Aug-19	17.0, 29-Aug-19
- NSDB	2.32 13-Dec-20	2.32 13-Dec-20
- Program	2.22 12.05.2022	**2.25** **10- Jul -24**

6. Software functions and added features.

Annexure I: List of changes carried out for TCU & CCU software versions.
Annexure II: Field Observations and analysis

7. Buffer

NIL

8. References

9. Appendices

i. WAG9_CCU_Control Software monitoring
ii. WAG9_TCU_Control Software monitoring

10. Release Scope

This document releases the above-mentioned parts for being used for testing in a secured environment and test rides (test rides accompanied by Siemens personnel).

For testing in service in public railway environment the requirements for normal service have to be fulfilled for the entire vehicle. The release for that is not part of this document. This document also does not provide the release for normal commercial service.

For testing in service and normal commercial service the project management has to give a separate release. If all conditions are met, this document may be referenced by the general vehicle release.

11. Author, Functional Coordination

11.1 Author

Ravuri Rama Satya Prakash RC-IN SMO RS EN 5

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11.2 Functional Coordination

This document was agreed with:

First and Last Name	Org. code	Review criterion	Date
Amod Dange	RC-IN SMO RS EN 5	Technical	09-Jun-2024

Revision Sheet:

Revision	Date	Section	Description of change
0	27.09.2021	All	1st Edition
1	20.10.2021	All	2nd Edition
3	03.02.2022	All	3rd Edition
3	29.06.2022	All	4th Edition
4	13.09.2022	All	5th Edition
5	30.12.2022	All	6th Edition
6	08.05.2023	All	7th Edition
7	04.07.2023	All	8th Edition
8	21.09.2023	All	9th Edition
9	04.12.2023	All	10Th Edition
10	10.07.2024	All	11th Edition

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Annexure: I, Ver. 2.06 WAG9-9K-EN5-RLN-12
Changes done in Ver. 2.06:

SW Changes in TCC: -

1. Panto Bouncing improvements.

a) Voltage retention feature has been activated in both TCU and CCU software's. Voltage retention feature will be activated only when locomotive speed is above 30Km/hr and will be deactivated if the speed of locomotive is below 25Km/hr.

b) PWI closed loop control error detection is now improved (DC 145) and related number of short pulse blockings is now removed.

c) 4QC control is improved by Parameter by Smoothing time adjusted (10 ms => 0 ms) resulting in fester DC-link Control.

Observations for the phenomena has been enclosed in Annexure: II

2. TCU isolation if pumps are not working.

SW Logic implemented for TCC isolation if the TCC reads that the pumps are on, and pressure is low for 30s or the CCU reads that the pressure is lower than 0.8 bar for 120s. If any of the conditions hold true than that TCC will be isolated.

3. Pulse blocking in energy saving mode.

4QC pulses blocking is initiated if the loco enters energy saving mode and TCC will be in Diode Mode.

SW Changes in CCU: -

1. **Throttle not responding after Neutral section.**

   It was noticed during the BVCBOnPulse (1sec) the hold coil supply (BVCBOn) was withdrew by TCC -ICU which was causing the throttle not responding as the pulse were blocked by TCU's which required reset of TCU. CCU SW has been modified to overcome the situation by considering the BVCBOn for pulse release. If BVCBOn is dropped BVCBOnPulse will also be drop for faster opening of VCB in any fault condition.

2. **Monitoring of TCC temperature in energy saving mode.**

   In recent experience it was noticed that TCC temperatures are reaching up to 70 deg when locomotive is continuously in energy saving mode for about 3 Hours. This raise in temperature TCC is taking protection by isolating the related TCC. To overcome this monitoring of TCC Air temperature has been considered in energy saving mode. If Air temperature reaches above energy saving mode will exit automatically and once Air temperature reaches below 60 deg.

3. **Activation of Energy Saving mode.**

   As per RDSO/2024/EL/MS/0482(Rev1) Coolant temperature monitoring has been added for entering to Energy saving mode. Coolant temperature should be below or equal to 55 Deg for entering energy saving mode. Crew message if locomotive goes into energy saving mode has been incorporated.

4. **HLC On command Logic.**

   HLC command was getting OFF in aux redundancy mode due to the inclusion of transformer oil pump status. Logic has been corrected by ignoring the oil pump status of transformer oil pump from the release of HLC on command in Aux redundancy mode.

5. **Compressor continuous running Sometimes**

   Whenever feedback of MR pressure switch was missing, stop sequence of compressor was not initiated due to which it keeps on running even though the pressure value has reached 10.5 Kg/cm^2. Thus, the logic has been revised by considering any of the pressure switch to ensure that compressor stops if any of the pressure switch provided the feedback that the MR has reached 10.5 Kg/cm^2.

6. **Aux Contractor on Command modified**

   In some cases, it was observed "O/p contactor short circuit" message was logging in ACU during the shifting to redundancy mode due to immediate reconfiguration of contactors. Time delay of 2 sec added for reconfiguration on receipt of Isolation request from ACU.

7. **Inclusion of basic flags Status.**

   Addition of running interlocks, traction interlocks, panto and VCB flags with Aux contactor status and battery charger diagnostics in environment by which can be identify the reasons of protections more easily.

8. DPWCS Changes

During DPWCS control, it was observed that there are certain active low signals which were creating discrepancy in interfacing the DPWCS control. Same has been implemented.

9. Shunting mode speed modified.

Regenerative brake response has been made faster for controlling the locomotive speed at 15 ± 0.5 kmph in shunting mode.

10. ACU 1 Frequency in redundancy Mode.

During redundancy, sometimes coolant pressure was not getting developed due to switching of setpoint frequency. Same has been rectified by addition of delay in ACU 1 output monitoring.

11. Energy meter reading correction in 6000Hp.

In earlier versions for 6K locomotive a patch was provided for energy meter corrections which has been implemented in SW without patch file.

12. Aux re-attempts monitoring.

During certain faults, Auxiliary system takes attempts to resolve the issue before going into isolation mode, these attempts were not monitored earlier and will be covered as restart attempts of Aux in CCU.

13. Inclusion of new Faviley VCD timings.

Siemens has incorporated the VCD timings of 32 sec for new VCD system of Faviley and this option can be configured from the locomotive setting option.

14. Transformer Oil temperature.

In DDU only max transformer Oil temperature were shown earlier instead of both sensor values. DDU software has been modified to show individual temperature values of both sensors.

15. TCC Cutout requested by bogie switch.

It was noticed that TCU-Master conflict was detected when TCC-1 isolated via Bogie switch only sometimes. This was due to non-transfer of TCU master status some time. Same has been corrected in CCU SW.

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ANNEXURE-II

Analysis

1. VCB Tripping : -

As per the diagnostics of TCU below are the causes which were causing the VCB Tripping.

Fault Code 80 & 81 in ICU 4QC.

Fault Code 81 (Which is equivalent to FC 80 & 81 in 4QC) in PWMI's.

a. Cause-1 PANTO BOUNCING : -

Field trails were conducted in WAP-7 Locomotive at speed range of 0-130 Km/h
Above mentioned fault codes were recorded by TCU at high speed, i.e. speed greater than 60 Km/h.

Based on fault code 81 reading of the 4QC, it was observed that there was incidence of panto bouncing during which line current goes to zero. This panto bouncing period lasts around 80 to 100 ms at high-speed operation.

When the contact between panto and Catenary disconnects, DC link voltage drops to approx. 2000V which increases the demand for more current. When the contact between panto and catenary is re-established, high inrush of line current is observed.

Peak of this line current can be seen in graph which is approximately 180 A. Thus, causing sudden rise in DC link voltage above 3100 Vdc.

This condition trigger's fault code 81 which signifies DC link overshoot above 3100 Vdc which results in opening of VCB.

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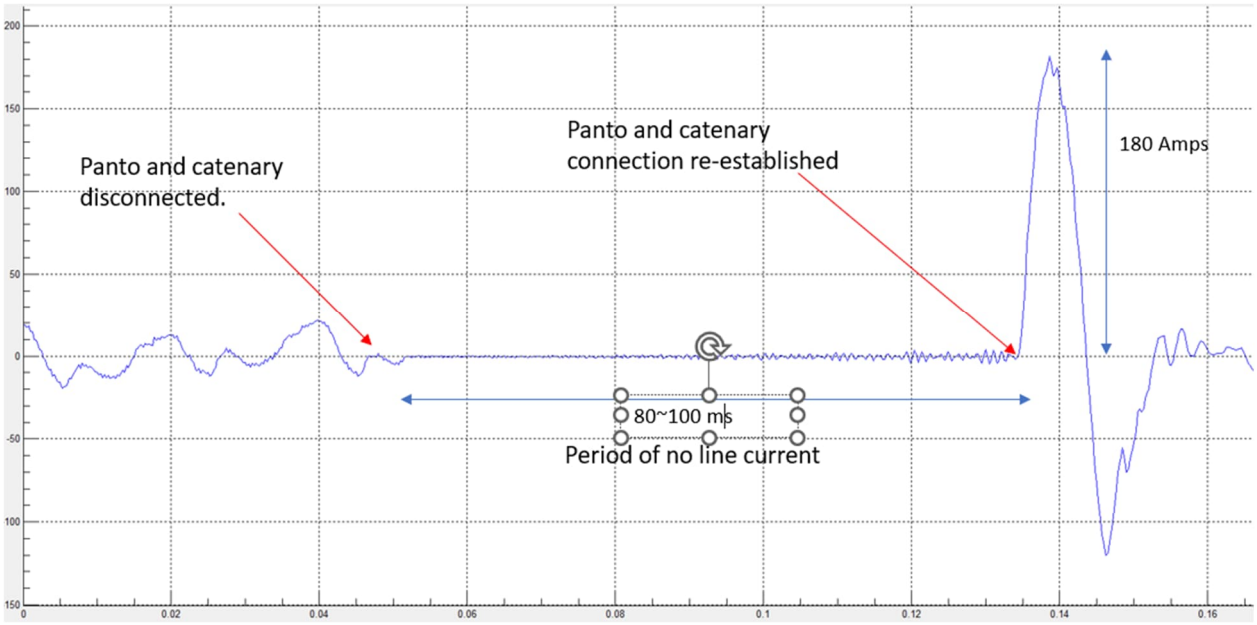
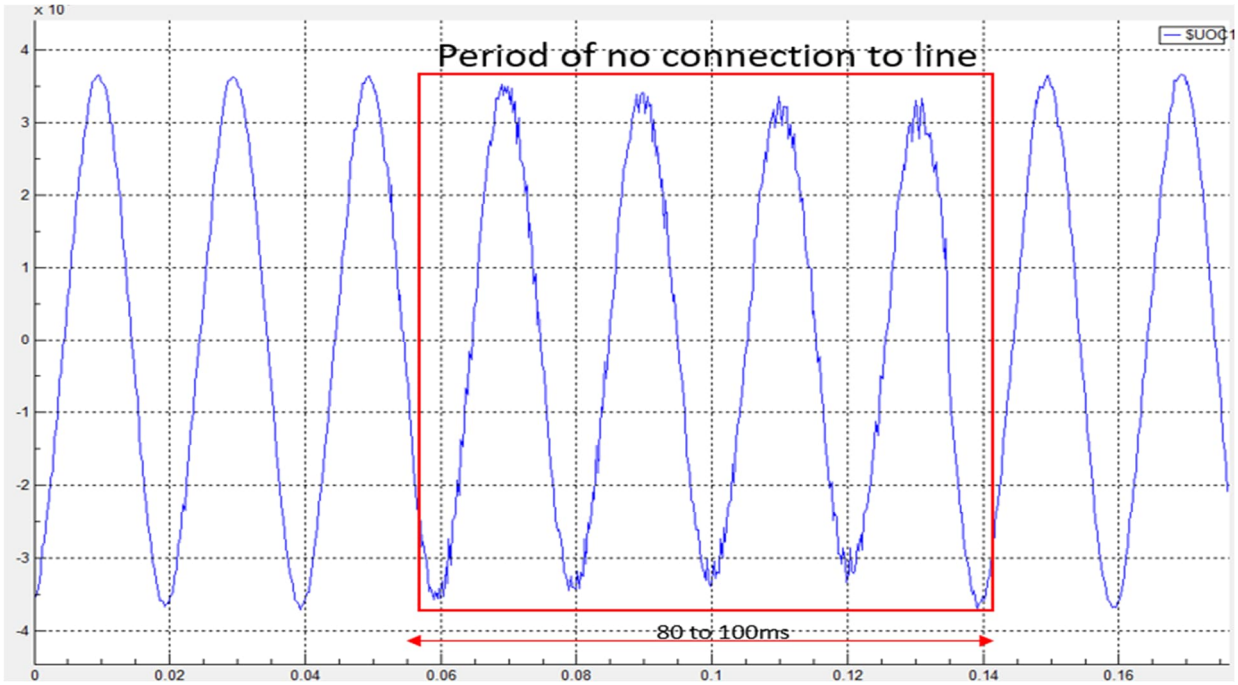


Recording of line current value during panto bouncing

Here, the period of line connection and disconnection is marked and observed time is around 80 to 100 ms. During this period, line current goes to 0.



Apparent line voltage measured by TCC during period of panto bouncing.

The voltage shown in the red box is not the actual line voltage but the apparent line voltage due to the continuous pulsing of 4QC.

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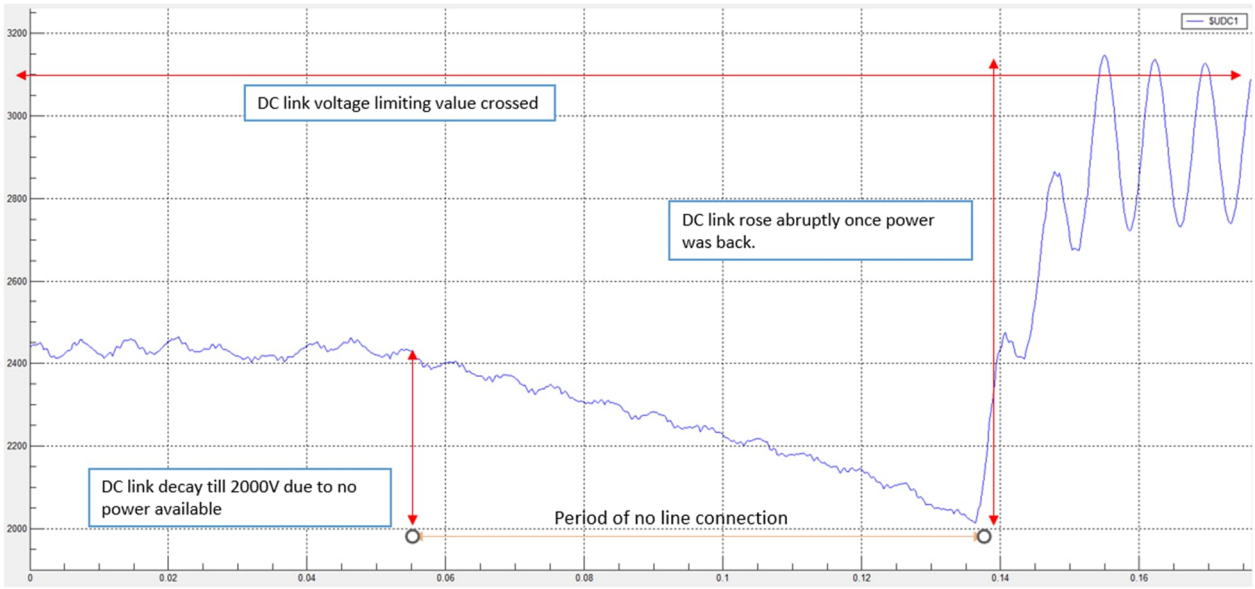
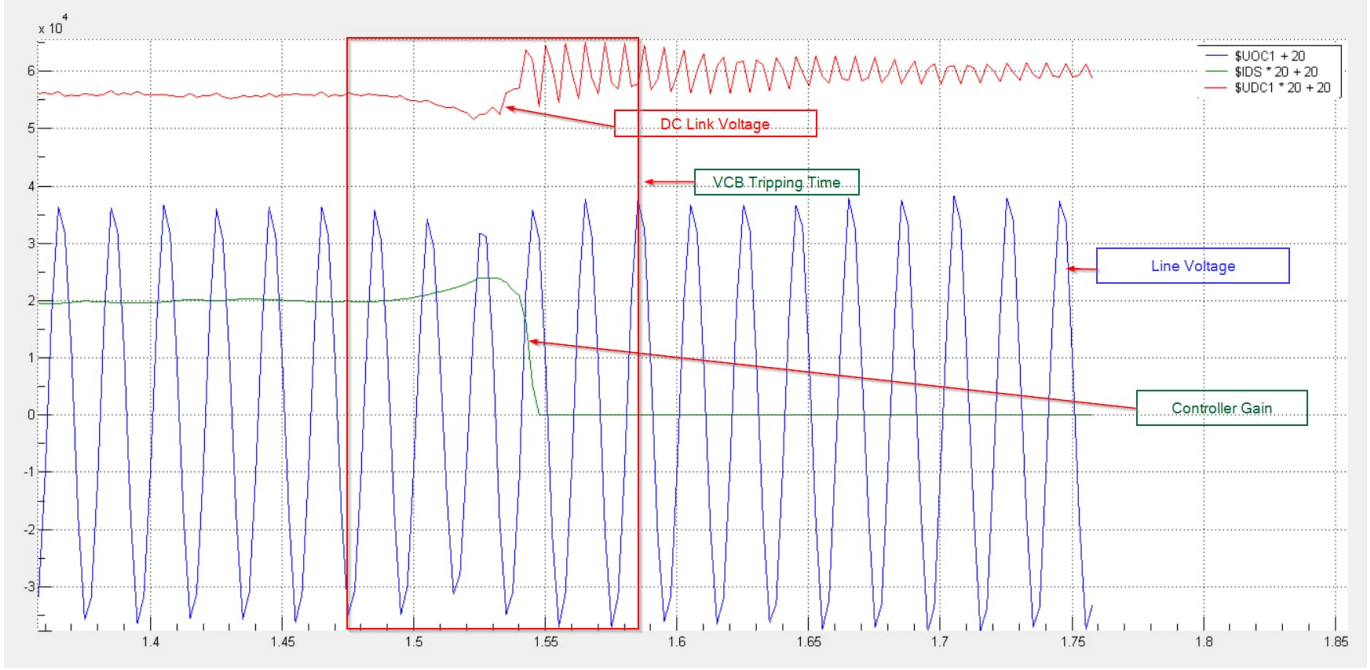


DC link voltage during panto bouncing.

It can be seen from above graph, once the connection between panto and catenary was re-established, there is sudden rise in the DC link voltage observed.

b. <u>Cause-2 Sudden Variation in Line Voltage</u> : -



It can be seen from above graph, that line voltage variation which was causing increase in line current and tripping VCB and causing DC-Link voltage over shooting.

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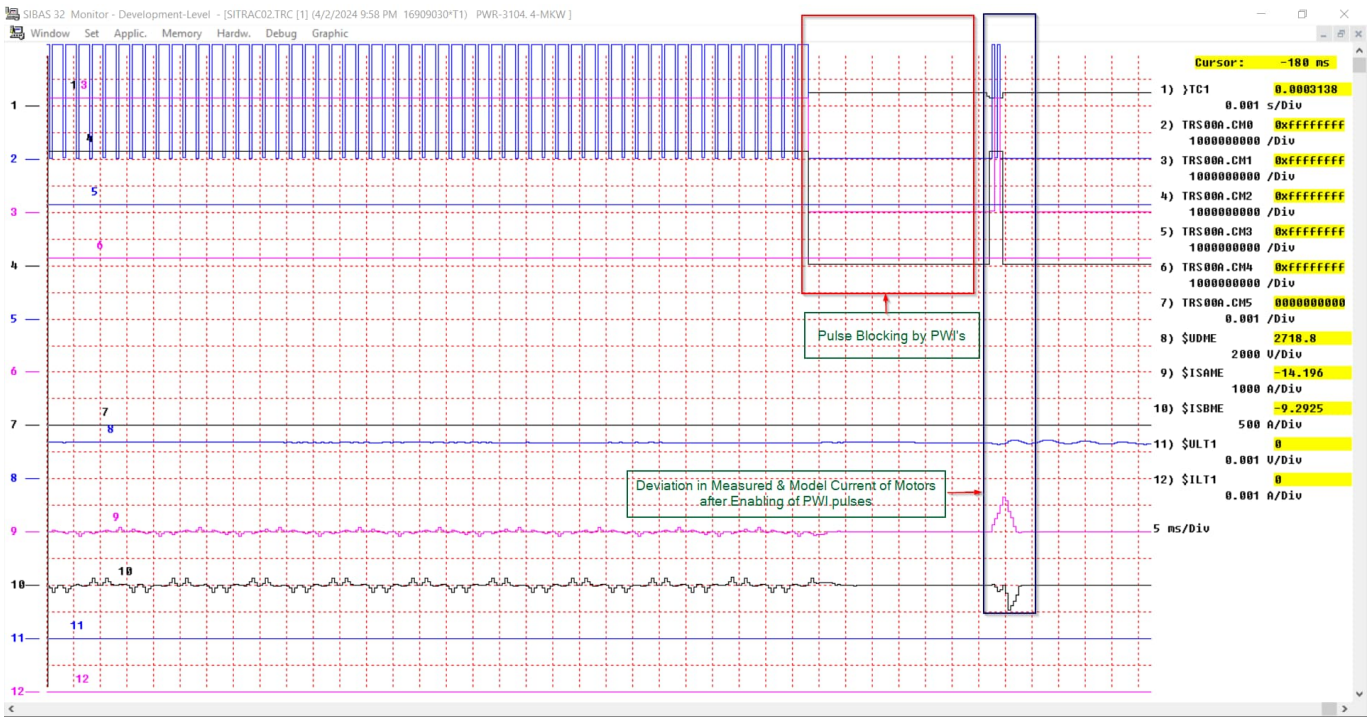
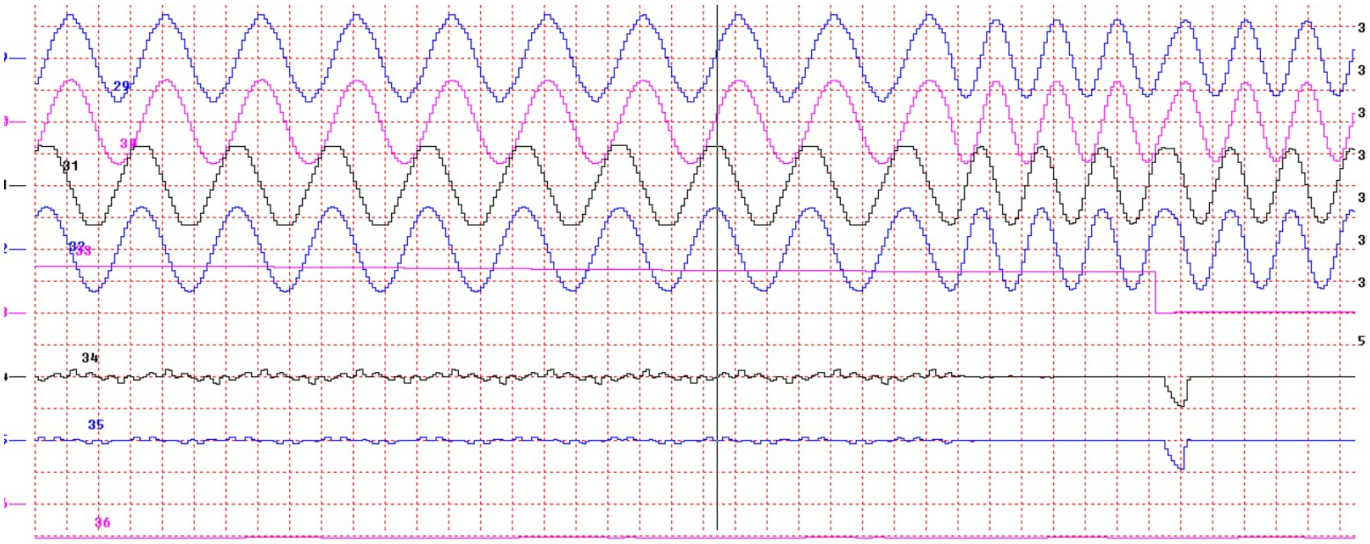
c. Cause-3 asynchronization of PWI's & Motors : -





As shown in the above figures shows Pulse blocking phenomena which is causing the synchronization of motors and PWI (Signals 9,10) in first picture. Also Pulse pattern deviation in of PWI's in signal no 31 in second picture.

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2. Throttle Not responding after Neutral section: -

As per the diagnostics of TCU below are the cause which were causing Throttle Not responding after Neutral section.

Fault code 40 " Main circuit breaker: status is not plausible".

VCB opening time is monitored by ICU 's which is 400ms. During the simulation it was observed that if any of the ICU's of both traction converter sees any error will immediately commands VCB to open, but still the VCB is in closing transition state. This was causing the VCB opening time beyond 400ms and PWI assuming VCB could not be able to open due to some reason and PWI's are taking protection by blocking the pulses and no traction was allowed there after till the TCUs are reset.

This was depending on the TCU's whichever is seeing this phenomenon use to get isolate and later gets back to normal operation by resetting the TCU.

Switching time of contactors [ms]	:	closing	opening
Precharging Contactor 1	:	20.000	20.000
Main Circuit Breaker	:		900.00
Discharge Contactor	:	100.00	20.000

Above Picture shows during the simulation time where the opening time of Main Circuit breaker is more than 400ms.