

2.4.2.5 Emergency brake

n 2425.01 f The emergency brake is applied in one of the following cases:

- Emergency brake required by vigilance control equipment
Input for MCE: Binary input 'Emergency brake required' and pressure switch emergency brake {06A, 269.1, Pn 69}
- Emergency brake required by the brake handle of automatic train brake. Input for MCE: Pressure switch emergency brake {06A, 269.1}
- Application of emergency brake by assistant driver's emergency brake cock (Input for MCE: Pressure switch emergency brake {06A, 269.1}).
- Application of emergency stop push button {06B,244}
Input for MCE: Binary input from the push button and pressure switch emergency brake {06A, 269.1}.
The VCB is opened and panto is lowered by application of emergency brake through emergency stop push button (by hardware).
- Emergency brake application on a coach
(ACP = Alarm chain pulling) no directly brake application, only buzzer activation inside the cab (detection by air flow sensor and brake pipe pressure)
- Emergency brake application by overspeed monitoring of System MEMOTEL
Input for MCE: Binary input {10A, 94.2}
see also Protective action n 2122.04 f
- Brake electronic failure; Input for MCE: Binary input {06H, 260.B}
see also Protective action n 2122.04 f

The application of an emergency brake in all the cases is directly and not controlled by MCE. The MCE detects that emergency brakes are applied and accordingly sets TE/BE demand to zero.

n 2425.02 f An emergency brake application by the emergency stop push button {06B, 244} shall generate a shut-down at any speed.

n 2425.03 f All emergency brake application sensed by the pressure switch {06A, 269.1} are suppressed, if the speed is below 2 km/h. (This is used in case of start/running with the train at a hill).

n 2425.04 f The push button for emergency stop {06B, 244} is active only in an active cab. There is no speed limitation, which will block the function of this push button (hardwired).

n 2425.05 f The binary MCE output 'automatic loco brake cut out' {06H,270.1} shall be zero in case of an emergency brake application.

- v 2425.06 f An emergency brake command is also valid for the slave loco.
- s 2425.07 f An emergency brake application sensed by the pressure switch {06A,269.1} will create a traction interlock --> n 2122.04 f
- n 2425.08 f In addition, all emergency brake applications creates a diagnostic data set (DDS).

2.4.2.6 Banking Mode

- n 2426.01 i Banking mode:
It will be possible to use locos as independent locos working together in a train composition. All locos, except the leading loco are therefore in banking mode.
- n 2426.02 i The brake pipe of rolling stock will not be charged by the banking loco, but it will be possible for the banking loco's driver to apply train brakes from banking loco in case of emergency.
- n 2426.03 f During set-up of loco (raising of pan), the driver will be informed by a priority 2 message if banking mode is active.

2.4.3 Slip/Slide control

- n 243.01 f The adhesion optimization is implemented on traction converter electronics for each bogie independently. The fine-tuning will be done during commissioning.
- n 243.02 f Performance requirements: see technical specification 3EHP510 115
- n 243.03 f The adhesion control may activate, if necessary, the anti slip brakes separately for the slipping bogie {06B, 282} or the sanding valves {06C,192} direction selective.
- n 243.04 f The wheel slip/slide (TE/BE actual / TE/BE demand < 0.5) will be indicated through an illuminated indication lamp {08E,92}.

2.4.4 Sanding

- n 244.01 f The sanding valves {06C,192} are controlled by the two MCE outputs to D&M {06C,260}. The driver may activate the sanding valves by the foot switch {06C,192} in each cab. The adhesion control may activate the sanding valves as well.

2.4.5 Indication train parting

- n 245.01 f The lamp indication train parting {06G,81.5} will be illuminated, if the pressure switch flow indication {06A,269.41} is switched on.

2.4.6 Shunting mode

- n 246.01 f The shunting mode ...

2.5 Auxiliaries

2.5.1 Hotel load (Train supply)

- n 251.01 i The hotel load is supplied by an auxiliary winding of the main transformer. The nominal ratings are: 750 VAC, 50Hz, 945 KVA. (BoBo only)
- v 251.02 i Operation in multiple unit --> 2.8.7

2.5.1.1 Operation equipment

- n 2511.01 f There is a spring loaded switch for hotel load supply {05D,169.1} on each cab:
- Pos. "On": Hotel load supply on
Pos. "0": neutral
Pos. "Off": Hotel load supply off
- n 2511.02 f This switch will operate the hotel load contactor {05D,32} through MCE. On each cab is a hotel load indication lamp {05D,169.3}, which lights up when the hotel load supply contactor is closed.

2.5.1.2 Switch conditions

- n 2512.01 f To close the hotel load contactor, the VCB shall be closed and the earth fault relay of hotel load circuit {05G,38.1} is not energised.
- n 2512.02 f In case the hotel load supply is switched off for any reason, switch on again will not be performed automatically. The driver shall push again the hotel load switch to Pos. "On" to close the contactor.
- n 2512.03 f Switching off the main circuit breaker opens the hotel load supply contactor as well.
- n 2512.04 f If the driver wish's to close the hotel load contactor and the main reservoir is not filled up, the contactor will not close as long as the pressure is not ok . A fault message 'Low main reservoir pressure' will be displayed.

2.5.1.3 Protective actions

- s 2513.01 f The current and earth fault of the hotel load supply is monitored by the MCE --> 3EHP 541 526.

s 2513.02 f

The MCE monitors the hotel load contactor {32} on stuck on and stuck off. The following measures are taken:

stuck off:

- priority 2 fault message is generated
- reset of hotel load contactor command

stuck on

- a priority 2 fault message will be generated.

s 2513.03 f

If the oil pressure in one transformer oil circuit is too low, (i.e. oil pump failed) the hotelload contactor is inhibited.

s 2513.04 f

If the pressure in main reservoir is less than 5.6 kg/cm², hotelload is switched off.

2.5.2 Auxiliary converter (BUR)

- n 252.01 i The internal software specification is included in Document 3EHE 620 298
- n 252.02 i Document 3EHW 500 458 includes the engineering specification of auxiliary converter.

2.5.2.1 Normal operation mode

- n 2521.01 i The three auxiliary converters supply the auxiliary system (3 x 415V)
- n 2521.02 i BUR1 supply: Oil cooler blower bogie 1 {02Z,59}
Oil cooler blower bogie 2 {02Z,59}
- n 2521.03 i BUR2 supply: Traction motor blower bogie 1 {02Z,53}
Traction motor blower bogie 2 {02Z,53}
Transformer oil pump 1 & 2 {02Z,62}
Traction converter oil pump 1& 2 {02Z,63}
- n 2521.04 i BUR3 supply: Scavenge blowers {02Z,55}
Main compressor 1 & 2 {02Z,47}
Battery charger {02Z,107}
- n 2521.05 f In normal operation mode the auxiliary inverter frequency is:
BUR1 : Step1: 24Hz, Step2: 37Hz, Step3: 50Hz,
Step3A: 37 Hz,
BUR2: 47/50 Hz
BUR3 50Hz
These frequencies shall be settable during commissioning.
- n 2521.06 f The following table shows the auxiliary converter contactors positions in normal operation {see scheme: 02Z,05I}:

Contactor	52/1	52/2	52/3	52/4	52/5
Position	closed	open	closed	open	closed

4 new contactors are added due to BUR redistribution of load. Software does not manage these contactors directly (hardwired). Following table gives an overview concerning these contactors:

Contactor	52.4/1	52.4/2	52.5/1	52.5/2
Position	open	closed	closed	open

2.5.2.2 Disturbances ,redundancy, auxiliary contactors

- s 2522.01 i Detailed information about protection auxiliary
--> 2.12 Protection concept
- r 2522.02 f If only one of the three auxiliary converter fails , the traction is still available and all auxiliary systems are supplied. If two auxiliary converters fails, traction and auxiliary power is no more available; loco fatal. A time delay of 5 sec. between opening the auxiliary contactor and closing the other auxiliary contactor to the redundant BUR shall be introduced.

r 2522.03 f

In case of BUR1 fails, BUR2 takes over the load of BUR1 as well. The following table shows the auxiliary contactor positions:

Contactor	52/1	52/2	52/3	52/4	52/5
Position	closed	open	closed	closed	open

4 new contactors are added due to BUR redistribution of load. Software does not manage these contactors directly (hardwired). Following table gives an overview concerning these contactors:

Contactor	52.4/1	52.4/2	52.5/1	52.5/2
Position	closed	open	open	closed

In this configuration, the frequency of BUR2 is limited to Step3A (37 Hz). The reason for this limitation is the overload protection for BUR2.

r 2522.04 f

In case of BUR2 fails, BUR1 takes over the load of BUR2 as well. The following table shows the auxiliary contactor positions:

Contactor	52/1	52/2	52/3	52/4	52/5
Position	open	open	closed	closed	closed

4 new contactors are added due to BUR redistribution of load. Software does not manage these contactors directly (hardwired). Following table gives an overview concerning these contactors:

Contactor	52.4/1	52.4/2	52.5/1	52.5/2
Position	closed	open	open	closed

In this configuration, the frequency of BUR1 is limited to Step3A (37 Hz). The reason for this limitation is the overload protection for BUR1.

r 2522.05 f

In case of BUR3 fails, BUR2 takes over the load of BUR3 and BUR1 takes over the function of BUR2 as well. The following table shows the auxiliary contactor positions:

Contactor	52/1	52/2	52/3	52/4	52/5
Position	open	closed	open	closed	closed

4 new contactors are added due to BUR redistribution of load. Software does not manage these contactors directly (hardwired). Following table gives an overview concerning these contactors:

Contactor	52.4/1	52.4/2	52.5/1	52.5/2
Position	closed	open	open	closed

In this configuration, the frequency from BUR1 is limited to Step3A (37 Hz). The reason for this limitation is the overload protection for BUR1. The frequency of BUR2 is fix 50Hz.

n 2522.06 f

The positions of all auxiliary contactors is monitored by feedback contacts. The monitoring starts after the MCE initialisation.

n 2522.07 f

The following table shows an action list of the possible situations: The first column 'Normal operation' explains which action shall be done, if this fault occurs during normal operation. For example: If contactor 52/1 will not close, processor BUR2 (default) shall be isolated.

Column 2,3 and 4 explains the consequences, if a contactor fault occurs and already a processor isolation is active.

	Normal operation	BUR1 isolated	BUR2 isolated	BUR3 isolated
52/1 stuck on	Inhibit BUR2&3 isolation		fatal	fatal
52/1 stuck off	BUR2 isolation	fatal		
52/2 stuck on	BUR3 isolation	fatal	fatal	
52/2 stuck off	Inhibit BUR3 isolation			fatal
52/3 stuck on	Inhibit BUR3 isolation			fatal
52/3 stuck off	BUR3 isolation	fatal	fatal	
52/4 stuck on	BUR2 isolation			fatal
52/4 stuck off		fatal	fatal	fatal
52/5 stuck on	Inhibit BUR1 isolation	fatal		
52/5 stuck off	BUR1 isolation		fatal	fatal

Description: stuck on = contactor will not open --> 21263.02
 stuck off = contactor will not close --> 21263.02
 fatal = auxiliary supply not available, Loco dead

n 2522.08 i All contactors {52} are interlocked by hardware not allowing any faulty contactor combination.

2.5.3 Main compressor

2.5.3.1 Operation equipment

- n 2531.01 f The spring loaded switch for compressor {06E,172} has the following three positions:
 Pos. "Off": Compressor off
 Pos. "Auto": Automatic pressure control
 Pos. "Man": Compressor on (manual pressure control)
- n 2531.02 i There are two main air compressors {06E, 47.1 & 47.2}. To switch on the compressor 1, contactor {47.2/1} is used. To switch on the compressor 2, contactor {47.2/2} is used.
- n 2531.03 f The following pressure switches are used for the compressor control:
1. The pressure switch "main compressor 8 kg/cm²" {06E,172.2} will be cut in at 8.0 kg/cm² and cut out at 10.0 kg/cm².
 2. The pressure switch "main compressor 8.5 kg/cm²" {06E,172.3} will be cut in at 8.5 kg/cm² and cut out at 10.5 kg/cm²
 3. The pressure switch "low main reservoir" {06E,269.4} will be cut in at 5.6 kg/cm² and cut out at 6.4 kg/cm².
- n 2531.04 f The compressors are supplied by auxiliary converter (normal operation mode: BUR3) with constant frequency (50 Hz). In case BUR3 is isolated, BUR2 will supply its loads with 50 Hz.

2.5.3.2 Operation mode: "Auto"

- n 2532.01 f In the mode "automatic pressure control", the compressor will be controlled by the above mentioned pressure switches .
- The pressure switch "main compressor 8 kg/cm²" {06E,172.2} closes when pressure falls below 8 kg/cm². It causes compressor 1 or 2 to run until pressure reaches 10 kg/cm². In this case both compressors will be used alternately.
 - The pressure switch "main compressor 8.5 kg/cm²" {06E, 172.3} closes when pressure falls below 8.5 kg/cm². It causes both compressors to run simultaneously until pressure reaches 10.5 kg/cm².
 - The pressure switch "low main reservoir" {06E,269.4} creates a start/running interlock --> 2.12.2 Protective actions and indicate the warning message "low pressure main reservoir" if the pressure falls below 5.6 kg/cm². Both compressors shall continue until pressure reaches 10.5 kg/cm², but the TE/BE can be restored once pressure reaches 6.4 kg/cm² (monitored by pressure switch {06E,269.4}).

2.5.3.3 Operation mode: "Man"

- n 2533.01 f In this mode, only a pneumatic overpressure relieve is used. Both compressors are running as long as the VCB is closed, the auxiliary converter are working and the driver keeps the spring loaded compressor switch {06E,172} in the position "Man"

2.5.3.4 Operation mode: "Off"

- n 2534.01 f In this compressor switch position both main compressors are disabled.

2.5.3.5 Starting cycle for one main compressor

- n 2535.01 f No more valid because both compressors run simultaneously because the setting of the pressure switches has been changed (i.e. the pressure switch which was earlier set to 7.5 kg/cm² is now set to 8.5 kg/cm²). Both compressors start now before the command for 1 compressor is executed. But in software, the logic for one main compressor remains untouched.

To avoid the compressor to start against air pressure, there is one unloading valve {06D,273.3} provided for both compressors. If both compressors do not operate, the unloading valve shall remain deenergised (MCE output 'EP valve unloading' = 0). During compressor start, the unloading valve shall be energised (MCE output 'EP valve unloading' = 1).

- n 2535.02 f Both compressors will be used alternately i.e. after a pump up of compressor 1, the next pump up will be done by compressor 2 and so on.

n 2535.03 f

1. Monitoring of low air pressure by pressure switch {06E,172.2}
--> n 2532.01 f
2. Ramp down the frequency of the auxiliary inverter (BUR3) from 50Hz to 0Hz with a rate of 5 Hz/sec. At the same time release the air by opening the unloading valve {06D,273.3} (if not already open). The ramp down slope and the lower limit must be adjustable during commissioning. Failure monitoring of oil flow/pressure & battery voltage (monitoring --> n 2125.03 f) shall be suppressed during ramp up/down
3. Close compressor contactor {47.2/2 or 47.2/1}
4. Ramp up the BUR frequency from 0Hz to 50Hz with a rate of 5 Hz/sec.
5. 3 sec. after the BUR is running on 50Hz, the unloading valve shall be deenergised.

Real values for programming: 0Hz corresponds to < 20 Hz
50 Hz corresponds to > 45 Hz

2.5.3.6 Starting cycle for two main compressors:

n 2536.01 f

1. Monitoring of low air pressure by pressure switch {06E,172.3}
--> n 2532.01 f
2. Ramp down the frequency of the auxiliary inverter (BUR3) from 50Hz to 0Hz with a rate of 5 Hz/sec. At the same time release the air by opening the unloading valve {06D,273.3} (if not already open). The ramp down slope and the lower limit must be adjustable during commissioning. Failure monitoring of oilflow/pressure & battery voltage shall be suppressed during ramp up/down.
3. Close both compressor contactors {47.2/2 and 47.2/1}
4. Ramp up the BUR frequency from 0Hz to 50Hz with a rate of 5 Hz/sec.
5. 3 sec. after the BUR is running on 50Hz, the unloading valve shall be deenergised.

n 2536.02 f

If one compressor is running and the pressure switch {172.3 or 269.4} requires the second compressor to start up, the following sequence will happen:

1. Ramp down the auxiliary inverter (BUR3) frequency from 50Hz to 0Hz with a rate of 5 Hz/sec. At the same time release the air with opening of unloading valve {06D,273.3} (= switch on the valve coil). Failure monitoring of oil flow/pressure & battery voltage shall be suppressed during ramp up/down.
2. Close the second compressor contactor {47.2/2 or 47.2/1}
3. Ramp up the BUR frequency from 0Hz to 50Hz with a rate of 5 Hz/sec.

4. 3 sec. after the BUR is running on 50Hz, the unloading valve shall be deenergised.

2.5.3.7 Specialities

- n 2537.01 f Auto drain valve function: By default the unloading valve {06D,273.3} is deenergised (MCE output 'EP valve unloading' = 0). Every 8 minutes it shall be energised for 5 seconds, if compressors are not running.
- v 2537.02 f Compressor control in multiple operation --> 288.01

2.5.4 Auxiliary compressor

- n 254.01 i The auxiliary compressor is used, if the pan pressure is too low to raise the pan. As long as the control circuit {126} is on, the control of the auxiliary compressor {48} is done by a pressure switch {06E,172.4}, independent of the MCE.

2.5.5 Air dryer

- n 255.01 f The air dryer {06D,284.5} shall be activated, if at least one main compressor is running (contactor main compressor {47/1 or 47/2 closed}).

2.5.6 Control of ventilation

2.5.6.1 General

- n 2561.01 i On the loco, there are two machine room blowers {03A,54}, two scavenger blowers for the machine room blowers {03A,56}, two traction motor blowers {53}, two oil cooling units {59}, two scavenger blowers for the traction motor blowers {55} and the oil cooling units.
- n 2561.02 i The machine room blowers and the corresponding scavenge blowers are directly supplied by the auxiliary transformer {67}. Therefore, these blowers are running as soon as the VCB is closed (independent of MCE).
- n 2561.03 i The ventilation for the traction motors and oil cooling unit is not bogie selective
- n 2561.04 i The blower motors are protected by circuit breakers and monitored through their auxiliary contacts.
- Circuit breaker traction motor blower {05F,53.1 /*}
 - Circuit breaker scavenge blower {05F,55.1 /*}
 - Circuit breaker machine room blower {05F,54.1 /*}
 - Circuit breaker machine room scavenge blower {05F,56.1 /*}
 - Circuit breaker oil cooling unit {05F,59.1 /*}

Circuit breaker monitoring --> 2.7.6

2.5.6.2 Normal operation

- n 2562.01 f The ventilation of oil cooling circuits is realised by application of three different steps/ frequencies taking into account the criteria listed below :
If any one of the conditions mentioned under each step is satisfied then the corresponding step will be selected. Step3 overrides step2; step2 overrides step1. In case of BUR 1 or BUR 2 isolation --> 2563.01
- n 2562.02 f Criteria for ventilation step 1:
- Temperature of converter oil --> Protective functions 3EHP 541526, 5.11
 - Temperature of traction motor --> Protective functions 3EHP 541526, 5.7
 - Temperature of the transformer oil --> Protective functions 3EHP 541526, 5.9
 - Either one or both line converters are triggering
 - A main converter including its control electronics is isolated
(The oil pump of the isolated converter continues running and therefore heats up the oil within the main converter. Since control electronics is off, oil monitoring is not being done, provision shall be made to avoid oil temperature exceeding its max. value)
- n 2562.03 f Criteria for ventilation step 2:
- Temperature of the converter oil --> Protective functions 3EHP 541526, 5.11
 - Temperature of traction motor --> Protective functions 3EHP 541526, 5.7
 - Temperature of the transformer oil --> Protective functions 3EHP 541526, 5.9
 - Actual speed < 30 km/h (hysteresis 5 km/h) and TE/BE > 70% (hysteresis 10%) of TE/BE max. 30 sec. ventilation afterwards if TE/BE was > 70%.
--> Protective functions 3EHP 541526, 5.9
- n 2562.04 f Criteria for ventilation step 3:
- Temperature of converter oil --> Protective functions 3EHP 541526, 5.11
 - Temperature of traction motor --> Protective functions 3EHP 541526, 5.7
 - Temperature of transformer oil --> Protective functions 3EHP 541526, 5.9
 - Actual speed > 30 km/h (hysteresis 5 km/h) and TE/BE > 70% (hysteresis 10%) of TE/BE max. 30 sec. ventilation afterwards if TE/BE was > 70%.
--> Protective functions 3EHP 541526, 5.9
 - Oil pressure failed in one transformer oil circuit --> Protective functions 3EHP 541 526, 5.9

(All the values mentioned under the three criteria shall be finally adjusted during trials).

n 2562.05 f Frequencies of the three steps (to be finally set during trials)
 Step 1: 24 Hz
 Step 2: 37 Hz
 Step 3: 50 Hz
 Step3A: 24/37Hz

2.5.6.3 Failure situations

s 2563.01 f In case of an auxiliary converter (BUR1 or 2) isolation, ventilation step 3A (37Hz) will replace step3.

2.5.7. Oil cooling circuits

2.5.7.1 Oil pumps

n 2571.01 i The oil pumps (2 oil pumps for the transformer {02Z,62} and for each main converter one oil pump {02Z,63}) work continuously during operation of the auxiliary converter (BUR2).

n 2571.02 f The oil pumps are protected by circuit breakers and monitored through their auxiliary contacts.

- Circuit breaker oil pump transformer {05G,62.1 /*}
- Circuit breaker oil pump converter {05G,63.1 /*}

2.5.7.2 Blower oil cooling unit

n 2572.01 i The blowers of the oil cooling units {02Z,59} are operated according to paragraph --> 2.5.6 Control of ventilation

2.5.8 Battery charging

n 258.01 i The battery is a NiCd Accumulator with a nominal capacity of 199Ah/C5A. (C5A is a value for the discharge rate. That means, if the battery will be discharged in 5 hours, the capacity of the battery is 199Ah). To get the nominal voltage, there are 78 cells connected in series.

n 258.02 f Technical datas: --> Eng. specific. Nickel cadmium accumulator:
 3EHW 510 061

- Nominal capacity: 199Ah / C5A
- Discharge stop voltage: 1.05V/Cell (82V)
- Floating voltage: 1.38V/Cell (111V, +/-1.35V)

This battery voltages are rated to an ambient temperature of 30°C.

In refer to these voltage values, all electrical components in the control circuit are specified for a nominal voltage of 110 VDC +25% / - 30%.

- n 258.03 f The battery voltage will be controlled with the DC-Link voltage of auxiliary converter (BUR3).
- n 258.04 f There are 3 redundant measurements to control the 110 V supply (BUR2&3):
- Battery voltage direct measured by a analog input to BUR 2&3
 - Battery current (charge/discharge) measured by 2 current sensors for BUR 2&3
 - 110 V supply current (current to feed the battery and the 110 V equipment) measured by 2 current sensors for BUR 2&3
- The following parameters are regulated through the DC-link control (BUR 2&3):
- The supply current is limited to max. 110 A
 - The battery charging current is limited to max. 40 A
 - The battery voltage is regulated with a maximum current of 40 A up to 111 V as long there is no overcurrent in supply current ($I_{\text{supply}} > 110 \text{ A}$) or in battery charging current ($I_{\text{batt}} > 40 \text{ A}$).
- n 258.05 f In case of battery charger failure, the battery shall feed the control equipment during approx. 5 hours starting with a full charged battery. Battery discharge protection --> n 2125.01 f

2.6 Safety systems

2.6.1 Vigilance control

2.6.1.1 General

- n 2611.01 i The vigilance control system is supplied by DAVIES & METCALFE (UK). The following description covers the interface between vigilance control and MCE. Ref. D3107 - Block diagram, A627 - Description

2.6.1.2 Interface description

- n 2612.01 f The MCE sets the following two binary signals to the vigilance control equipment to vigilance acknowledge:
1. MCE output 'Reset vigilance cycle' shall be set, if at least one of the following action is performed:
 - The driver moves the TE/BE throttle (detection of a difference between old and new value bigger than 3%)
 - Operation of sander foot switch {06C, 192.1} (= detection of +/- edge generates a 1sec. pulse).
 2. MCE output 'vigilance control reset penalty brake' shall be set, if the TE/BE throttle {08C/D,150} is in Pos."0" .
- n 2612.02 f The MCE input 'vigilance warning' will activate the vigilance buzzer in the activated cab, MCE outputs 'Buzzer cab 1/2 black & red'.

- n 2612.03 f The MCE input 'Emergency brake required' senses a vigilance emergency brake application. Action: Traction interlock, fault message.
- n 2612.04 f The MCE shall cut out the vigilance control (MCE output 'Vigilance control') if speed is less than 1.5 km/h.
- v 2612.05 f Vigilance control in multiple operation see --> 2822.01

2.6.2 Fire detection

- n 262.01 i The fire detection equipment {11B,212} is supplied by CERBERUS Switzerland.
- n 262.02 f Fire in machine room is detected, if the MCE input 'Fire alarm' and the MCE input 'Fire warning' is activated. This will cause the following actions:
- buzzer {11B,238} activated by hardware.
 - start/running interlock (TE/BE removed)
 - priority 1 fault message
- Driver to decide on action to be taken (i.e. loco shutdown or proceed in the event of false indication).
- multiple operation see v 2815.02 f
- n 262.03 f Smoke in machine room is detected, either the MCE input 'Fire alarm' or the MCE input 'Fire warning' is activated. This will cause a priority 2 fault message.
- n 262.04 f To reset the fire alarm, the driver shall press the reset push button on the fire detection unit. Second he shall press the fault acknowledge push button, which will reset the fault lights and the fault message.
- n 262.05 f The detection of a failed fire detection unit, MCE input 'Failure fire detection equipment' will create a priority 2 fault message. Afterwards, there is no limitation to drive the loco.

2.7 Miscellaneous functions

2.7.1 Wheel flange lubrication

- n 271.01 i The wheel flange lubrication {10A,300.3} will be controlled by MEMOTEL speed recorder & indicator equipment {10A,94.2}.

2.7.2 MEMOTEL speed recorder & indicator

- n 272.01 f The speed ranges are:
 - WAP-5: 0..180 km/h
 - WAG-9: 0..120 km/h
 The MCE interface consists of 3 binary inputs, which triggers the following actions:
 1. "Alarm"
 - priority 2 fault message "Speedometer failed"
 2. "Speed 105%"
 - activate the buzzer {11B,238} by MCE output 'Buzzer cab 1/2 black'.
 3. "Speed 110%"
 - emergency brake application (hardwired)
 - traction interlock
 - priority 1 fault message "Overspeed"
- n 272.02 f There is no analogue input from "Memotel" to MCE which is wheel diameter compensated. The internal MCE vehicle speed is sensed by traction motor speed sensors {93.2} and calculated by half worn wheels (1054 mm). Memotel speed not provided to ABB, driver display only.

2.7.3 Diagnostic terminal

- n 273.01 f A display for following diagnostic information is used:
 - Indication of diagnostic data on subsystem level : Status / Fault
 - Indication of information for corrective action in case of failure / fault
- n 273.02 f Whenever a fault of any priority occurs, fault message on display will occur and illuminated push-button for fault acknowledgement {17A,163.1} will light up. In case of priority 1 fault the fault status lamp {17A,163 } will start blinking in addition. If a fault with priority 1 is indicated, a fault with priority 2 will be suppressed.
- n 273.03 f Fault and the fault-message can be acknowledged by pressing fault acknowledge push button .Then the light of push button will be off and diagnostic display will be cleared. If driver fails to acknowledge fault of priority 1 the loco remains in the disturbance node. If the driver fails to acknowledge priority 2 fault the fault message will remain on diagnostic display until a new one super scribes the present message. No further action is taken.

- n 273.04 f If an isolation is performed the fault status lamp {17A,163 } will glow continuously otherwise it will be off after fault acknowledgement. Isolation of affected subsystem will be done automatically, if required, by pressing the fault acknowledge push button {17A,163.1}.
- n 273.05 f For further information about diagnostic refer to Engineering Specifications 3EHP 510190 and 3EHP 510191.

2.7.4 Simulation mode

2.7.4.1 General

- n 2741.01 f The operation mode **Simulation** is used for MCE - testing. In this mode the pan control and some disturbance messages are disabled. The loco operation is similar to the normal operation but without catenary power. This mode is designed for commissioning and maintenance staff to test MCE Software without any danger to the loco.

2.7.4.2 Turn-on/off

- n 2742.01 f To activate the simulation mode, the key switch {17A,179} is to turn in position "SIM" before the MCE is under power (cab activation key switch {08A,125} in Pos."D"). In the same way, it is only possible to disable the simulation mode (key switch {17A,179} to Pos."I"), if the MCE is not active.
- n 2742.02 f If somebody turns-on or off the simulation mode during MCE active in normal mode, the key switch position will be ignored.
- n 2742.03 f It is possible to use the simulation mode, even if the loco is earthed and the main converter DC-link is earthed.
- n 2742.04 f Note: During simulation mode there is no battery charging and no compressor running. The parking brake shall be applied by MCE.
- v 2742.05 f In multiple operation the key switches {17A,179} on both locos shall be in the same position, otherwise the pans are disabled and it creates a fault message on both locos.

2.7.4.3 Set-up and simulated driving

- n 2743.01 f Operations:
1. Simulation key switch {17A,179} to Pos."SIM"
 2. MCE activation; cab activation key switch {08A,125} to Pos."D"
 3. Parking brakes applied and release of parking brake is inhibited.
 4. Push the pan switch to Pos."UP" {05A,129}. The pan is blocked and will not raise, but the software will simulate the raising. The displayed catenary voltage is simulated by software.

5. Push the VCB switch to Pos."On". The VCB will close.
6. After the direction is selected, the simulated set-up of DC-link charging starts. The gate units are supplied.
7. Set the TE/BE Demand, the actual tractive/braking effort will be displayed on the meters {08E,79}. The MCE will also simulate the corresponding loco acceleration and speed. The speed information will be displayed on the diagnostic terminal (MEMOTEL equipment is not working). In simulation mode, braking interlocks are to be ignored.

n 2743.02 f

Other functions:

- Fault handling
- Emergency brake
- Hotel load
- The sander and wheel flange lubrication are not active
- The vigilance control is active

2.7.5 Test of indication lamps

n 275.01 f

The test of indication lamps will be executed automatically after each start-up (periphery test node of master flow chart) of MCE.

n 275.02 f

The test includes all indication lamps. The lamps which are not controlled by MCE shall be activated setting corresponding MCE output 'Lamp test cab1' on cab 1 or MCE output 'Lamp test cab2' on cab 2.

2.7.6 Miniature circuit breakers (MCBs) / Fuses

n 276.01 f

MCBs which are equipped with auxiliary contacts, will generate a priority 2 fault message in case of tripping. MCB trips are indicated on a group/cubicle basis, not for individual MCB's. A fault message is displayed to inform the driver which area to check.

n 276.02 f

The MCBs are allocated to auxiliary circuit cubicle 1 & 2 and auxiliary converter box 2.

MCBs / fuses in cubicle 1:

- Traction motor blower {05F,53.1/1}
- Scavenger blower traction motor {05F,55.1/1}
- Scavenger blower machine room {05F,56.1/1}
- Machine room blower {05F,54.1/1}
- Auxiliary fuse 415V/110V (40A) {05F,41}
- Oil cooling unit trafo/converter {0 5G,59.1/1}
- Oil pump transformer {05G,62.1/1}
- Oil pump converter {05G,63.1/1}

- Compressor 1 {05F, 47.1/1}

MCBs in cubicle 2:

- Traction motor blower {05F,53.1/2}
- Scavenger blower traction motor {05F,55.1/2}
- Scavenger blower machine room {05F,56.1/2}
- Machine room blower {05F,54.1/2}
- Oil cooling unit trafo/converter {0 5G,59.1/2}
- Oil pump transformer {05G,62.1/2}
- Oil pump converter {05G,63.1/2}
- Compressor 2 {05F, 47.1/2}

MCB in BUR Box 2:

- Battery charger {05G,100}

2.7.7 Neutral section

- n 277.01 i In case of crossing a neutral section all required operations will be done manually by the driver as prescribed for the purpose by India Railways.
- n 277.02 i During crossing a neutral section the VCB is opened. The Pantograph may or may not be lowered.

2.7.8 Energy consumption

- n 278.01 f The energy counters are displayed in kWh (kilo Watt hours) on the diagnostic screen. Two values are displayed: energy consumption and regenerated energy. These values are stored in the battery buffered data base of processor DIA1. That means, on the screen the accumulated values are displayed.
- n 278.02 f After 50'000'000 kWh the counter will stop and restart from zero. (Limitation is due to the internal used data given format)

2.8 Multiple operation

2.8.1 General

- v 281.01 d There are maximum 2 locos in multiple operation. The locos in multiple operation are direct coupled (no coaches between).
- v 281.02 d Usually during driving the active cab is always in front of the train, except during coupling. In case of abnormal situations, driving from any intermediate cab is also possible.
- v 281.03 f Train-bus configuration (= Initialisation train-bus):
The train bus configuration for a successful multiple operation is only possible from the front cabs. Configuration from a rear cab is considered as a single loco operation. After normal coupling the train-bus checks automatically the new configuration. The occupied loco will be the **master** loco, the other loco in remote control will be the **slave** loco.
- v 281.04 f The configuration of a multiple unit will only be possible if the slave loco is inactive and the master loco is active.
- v 281.05 f Multiple operation, provision is made for each line converters to work on a different control angle to minimise harmonics.
- v 281.06 f Multiple operation between WAP-5 and WAG-9 is not recommended.

2.8.2 Coupling

2.8.2.1 General

- v 2821.01 d Two locos are coupled, if
 - they are mechanically and pneumatically coupled and
 - the UIC cable is connected

2.8.2.2 Normal coupling

- v 2822.01 f For multiple operation following actions shall be taken:
 1. Both locomotives shall be shut-down and the cab activation key switches are in Pos."0"
 2. Mechanically, pneumatically coupling and connection of UIC cable between the two locos.
 3. On the slave loco both cab activating key switches {011A, 125/1-2} are in the '0' position, which disables the vigilance unit.
 4. Set the brake feed pipe cock (Pn 136) to the closed position on the slave loco (open to the master)

5. The driver shall turn the cab activation key switch to Pos."D". As soon as the indication lamp test starts, the driver shall turn back the key switch to Pos."0". Now the slave MCE is in the self-hold mode.
6. During the self-hold mode on the slave loco, the driver shall turn the cab activation key switch to Pos."D" on the master loco. The control electronic of the master loco will start to configure the train-bus.
7. The driver may check the information about the train-bus configuration on the diagnostic terminal (screen '12'). After completion of train bus configuration (communication to slave loco ok), the screen will show the Loco numbers of master and slave loco, if the driver chooses screen '12'. If the communication to the slave loco fails or there is no slave loco, the Loco number is 00000.

2.8.2.3 Coupling to a loco with an active cab

- v 2823.01 f More than one cab active in a multiple unit consist, will create a shut-down and a fault message on both locos, thereafter the procedure --> v 2822.01 f needs to be performed.

2.8.3 Uncoupling

- v 283.01 f Status: One loco is master and the other one is slave. Both are ready for drive. The following action shall be done for a normal shut-down and uncoupling:

1. Both locos shall be shut-down (VCB off, Pan down)
2. Disconnect the UIC cable and uncouple the locos
3. The slave loco is now also ready to set-up as a single unit

- s 283.02 f If the train-bus link is interrupted, by any reasons, and both locos are set-up or driving, the protection creates a controlled shut down on the slave loco, pan is lowered on the slave loco and a fault message appears on the master loco.

2.8.4 Pantograph

- v 284.01 f In multiple unit the two most distant pantographs shall be used. Settable during commissioning (behaviour to be checked during trials). The UIC connections establish the free end of the locomotive.
- v 284.02 f The pan up/down command from the master loco is used for slave loco panto control as well.

2.8.5 Main circuit breaker (VCB)

- v 285.01 f The VCB on/off command from the master loco is used for the slave loco as well, except in protection mode.

- v 285.02 f The VCB on the slave loco shall be switched on 0.5 seconds delayed to the VCB on the master loco (settable during commissioning). For switch off, there is no delay.
- s,v 285.03 f If a fault with VCB off on the slave loco occurs, the VCB will close automatically after pressing the fault acknowledge push button on the master loco (if the fault has disappeared). The VCB on the master loco will remain closed.
- s,v 285.04 f If a fault with VCB off on the master loco occurs, the VCB will open on the slave loco as well, because of synchronising the auxiliary relays of VCB {05B, 136.4} on both locos.

2.8.6 Regenerative braking effort limitation

- v 286.01 f In multiple operation, there is a limitation of electric braking effort assigned on the slave loco. The default value, adjustable during commissioning, is 100% braking effort available. Braking effort on slave loco reduced to avoid oscillatory effects during speed checking between locomotives during speed.
- v 286.02 f In multiple operation the speed control on the slave loco is disabled. The master loco speed control will transmit the TE/BE demand to the slave loco using the train-bus. The slip/slide control of the slave loco is independent of the master loco.

2.8.7 Hotel load

- v 287.01 f In multiple operation the hotel load supply contactor {05D,32} on the master loco shall be in off-position. Only the slave loco which is coupled to the train is able to feed the hotel load supply.
- v 287.02 f The command of the hotel load switch {05D,169.1} on the master loco will be transmitted to the slave loco by train-bus. If the VCB is closed the hotel load supply contactor {05D,32} will close only on the slave loco.
- v 287.03 f The indication lamp {05D,169.3} will be illuminated on the master loco, if the hotel load supply contactor on the slave loco is closed.
- s 287.04 f The protection as for single loco --> s 2513.01/02 f
- s 287.05 f Hotel load supply in multiple operation is only via the slave locomotive possible. If not possible to energise the hotel load contactor on the slave loco, a corresponding fault message is displayed on the master loco.

2.8.8 Compressor control

- v 288.01 f The compressor switch positions (Off,Auto,Man) from the master loco, will be transmitted to the slave loco. In position "Man" or "Off" all compressors in both locos are directly controlled. In position "Auto" the following situations are possible:
- v 288.02 f The closed pressure switch 8 kg/cm² {06E, 172.2} on the master or slave loco causes one compressor on each loco to run. Each loco alternate the compressors individually.
- v 288.03 f The closed pressure switch 8.5 kg/cm² {06E, 172.3} or the switch 5.6 kg/cm² {06E, 269.4} on the master or slave loco causes all compressors of multiple unit to run simultaneously.

2.8.9 Neutral section

- v 289.01 i The driver's actions are the same as in single unit.

2.8.10 Parking brake

- v 2810.01 f It will not be possible to start the multiple unit (start/running interlock), if there is any parking brake applied. --> 2.4.2.4 Parking brake
- v 2810.02 f An applied parking brake, either on the master loco or on the slave loco, will be indicated through an illuminated push button {06B,268} on the active cab of master loco.
- v 2810.03 f If the master loco has released parking brakes before coupling to a slave loco, the master loco will apply the parking brake, because the slave loco will have an applied parking brake, after deactivation of cab.

2.8.11 Emergency brake

- v 2811.01 i The only possibilities to activate an emergency brake on the slave loco is the brake handle automatic train brake {293} or the assistant driver's emergency brake cock.
- v 2811.02 f If the pressure switch {06A,269.1, Pn69} either on the master or slave loco is sensing an emergency brake application, the resulting emergency brake command will be valid for both locos. The master for all other emergency brake commands is the leading unit in multiple operation.

2.8.12 Other brake functions

- v 2812.01 f The TE demand will be set to zero, if brake cylinders of one bogie in multiple unit will have air pressure, pressure switch {06A,269.6} and the speed is above 10 km/h.
- v 2812.02 f In case of an electric brake failure on one loco in multiple unit, the electric brake of the other loco will remain operating.

2.8.13 Trailing mode

- v 2813.01 d Trailing mode means that the master loco of a multiple unit is not able to do tractive effort i.e. isolation of 2 bogies, but the cab of the master loco is still used to control the slave loco.
- v 2813.02 f The conditions of the master loco are:
- VCB off, pan down
 - train-bus correct working
 - pneumatic brake system is correct working, brake control from leading loco
- v 2813.03 f The tractive/braking effort meters {08E,79.1/2} will indicate the values from the slave loco.
- v 2813.04 f If tractive/braking effort limitations for multiple unit are active, they will be set back to single unit.
- v 2813.05 i All equipment on the master loco will be supplied from the battery which gives a maximum possible operation of 5 hours.

2.8.14 Sanding

- v 2814.01 f The manual sanding command by pressing the foot switch {06C,192} is valid for both locos. In case of multiple operation the automatic sanding is not a global command (only valid for the loco which has slip/slide problems).

2.8.15 Fire detection

- v 2815.01 f A fire alarm on the slave loco shall be indicated on the leading loco by buzzer {238} (buzzer activated by MCE output).
- v 2815.02 f Fire in machine room is detected, if the MCE input 'Fire alarm' and the MCE input 'Fire warning' is activated. This will cause the following actions on the slave loco:
- VCB OFF (only on slave loco)
 - priority 1 fault message (on master and slave loco)

2.9 Disturbances / Faults

2.9.1 General & definitions

- n 291.01 i For detailed information about diagnostic functions see the following documents:
3EHP 510 190: Diagnosis functionality
3EHP 510 191: Diagnosis screen structure
- n 291.02 d **Subsystem:**
Subsystems are a part of the complete software functionality, which will help to assign a fault. All subsystems are listed in the document 3EHP 510 191. Most of the subsystems can be isolated.
- n 291.03 d **Isolation of a subsystem:**
A steady priority 1 fault or a priority 1 fault which occurs two times within 30 min. will create an isolation of the corresponding subsystem. If a subsystem is isolated, all faults and signals are cut out of this subsystem. An isolation message will appear on the diagnostic terminal.
- n 291.04 d **Fault acknowledge:**
The acknowledge will be executed manually by pressing the fault acknowledge push button. The acknowledge pulse will reset all fault flip-flop's. If the fault has disappeared, the loco will be ready for drive again.
- n 291.05 d **Diagnostic data set (DDS)**
One fault will trigger one DDS. The DDS includes information on the specific fault i.e. Fault number, processor identification, trigger date/time, fault description and environment data. All DDS are stored in a battery buffered data base on the DIA1 processor (412.U; PP B624 B01). The data base ring buffer has a capacity of around 3000 DDS before the memory is overwritten. The buffer battery will be tested after each initialisation. If the test fails, the light emitting diode (LED) H38.4 on the processor front panel will be illuminated and a message in the cab is displayed. The access to the data base is possible with the software tool MICWDIAG.

2.9.2 Disturbance handling

- s 292.01 f There are priority 1 and priority 2 faults which can occur. A priority 1 fault causes a protective action, a priority 2 fault not. All diagnostic data sets (DDS) are stored in the battery back-upped diagnostic data base. The following tables shows the actions after a disturbance has occurred:

s 292.02 f

Priority 1 fault:

1. Fault detection; set a fault flip-flop
2. Protective action will be executed (i.e. protective shut-down, VCB off, traction converter blocking)
3. The master flow chart node is going to a disturbance node
4. Registering of diagnostic-data-set (DDS) in processor DIA1
5. The isolation counter will be increased one step
6. Activation of fault acknowledge light (red) {17A,163.1} and fault message for the driver on the display. In addition, the fault status lamp (yellow) {17A,163} will be blinking by software (f = ca. 2Hz).
7. The driver will acknowledge the fault by pushing the fault acknowledge push button {17A,163.1}.

In meanwhile the fault is disappeared:

- 8a. The fault flip-flops will be reseted
- 9a. The master flow chart node is going to a normal state node
- 10a. The fault lights {163.1 + 163} and the fault message will disappear
- 11a. The driver can continue with normal operation
- 12a. After a time period of 30 min the isolation counter will be reset.

Fault is still active or a second fault occurs before the isolation counter was reset.

- 8b. The fault flip-flops will get a reset pulse and a set pulse again. This new positive edge will increase the isolation counter. That will produce a software-signal 'isolation expected'.
- 9b. Fault light and fault message will get a new trigger. The fault acknowledge push button is illuminated and the fault status lamp is blinking again.
- 10b. After pressing the fault acknowledge push button, the isolation of subsystem will be executed. The fault status lamp will change to a steady light. The illuminated fault acknowledge push button will extinguish.
- 11b. The fault message will exchanged by an isolation message on the diagnostic display. The isolation message will inform the driver about the consequences of these isolation.
- 12b. The display screen returns to the standby screen, this after pushing 'ENTER'.

s 292.03 f

Priority 2 fault:

1. Fault detection
2. Registering of diagnostic-data-set (DDS) in processor DIA1
3. Activation of fault acknowledge light (red) {17A,163.1} and fault message for the driver on the display.
4. The driver will acknowledge the fault by pushing the fault acknowledge push button. The display goes back to the standby screen.

s 292.04 f

Diagnostic data set (DDS):

1. Fault detection
2. Registering of diagnostic-data-set (DDS) in processor DIA1

s 292.05 f

If the back-up battery for the non-volatile memory of the diagnosis processor is nearly empty, the driver shall be informed by a display message. To prevent loss of diagnosis data, the battery shall be exchanged within a few days.

2.9.3 Isolation of subsystems

s 293.01 f

A subsystem which is isolated, will remain isolated as long as the MCE is supplied.

s 293.02 f

When more than one subsystem are expected for an isolation, after pressing the fault acknowledge button, all of these subsystems will be isolated simultaneously.

2.9.4 Isolation of traction bogies

s 294.01 f

The control electronics can isolate the subsystem 'traction bogie 1' or 'traction bogie 2' if a major fault has occurred --> s 292.02 f. An isolation of such a subsystem means, that only half traction power is available. The subsystem traction bogie 1/2 includes: main converter, traction motors or converter control electronics (ALG, SLG).

s 294.02 f

A traction bogie can be isolated manually, by the rotary switch bogie cut out {17B, 154}. In position "I" bogie 1 will be isolated, in position "II" bogie 2 will be isolated. Position "I+II" will cut out both traction bogies. Usually, the rotary switch is in position "NORM". It is only allowed to cut out a bogie, if the MCE is switched off. Switching of the rotary switch bogie cut out during operation (cab activation key switch on Pos. "D") will be ignored.

s 294.03 d

Bogie isolation by MCE or manually by rotary switch, will isolate the subsystem 'Traction bogie 1 or 2'. If one bogie is isolated the complete control electronics (processor SLG and ALG) are isolated as well.

2.9.5 Isolation of harmonic filter

s 295.01 f In case of isolation of the harmonic filter (contactor {8.1}) the maximum TE shall be limited to 0 kN.

2.10 Failure mode operation

2.10.1 Definition

n 2101.01 d The failure mode operations permits to drive the locomotive, if the angle transmitter {08C,150.1} of the master controller is inoperative.

n 2101.02 d In this mode the master controller operates with the auxiliary contacts of the throttle --> r 2412.02 f

2.10.2 Activation

n 2102.01 f To activate the failure mode operation the rotary switch {17A,152} in the machine room shall be turned to position "I".

n 2102.02 f The failure mode operation will be required if the information of the angle transmitter {150.1} does not match with the information of the auxiliary contacts of the throttle. Mismatch means, the difference of the auxiliary contact position (corresponding analogue value --> r 2412.02 f) and the absolute angle transmitter value is greater than 40% of full scale. The fault detection is 2 sec. delayed. The following actions will be taken:

1. Traction interlock by MCE --> n 2122.04 f
2. A priority 1 fault message will be issued
3. The driver has to disable the angle transmitter by turning the rotary switch {152} in the machine room to position 'I'.
4. Driver has to bring TE/BE handle to zero position (release signal for control electronics)
5. New TE/BE value may be set by the driver

n 2102.03 f The TE/BE demand ramp-up time between the auxiliary positions of the master controller will be the same as usual .

2.11 Redundancy

2.11.1 Auxiliary system

- r 2111.01 d Three auxiliary converters (BUR's) support the auxiliary power supply (3x415V). If only one BUR fails, the two other units have the possibility to feed almost the complete auxiliary power. --> 2.5.2.2 Disturbances, redundancy, aux. contactors

2.11.2 Traction equipment

- r 2112.01 d Each traction bogie consists of one separate main converter. Each traction bogie can be isolated, if a major fault has occurred. --> 2.9.4 Isolation of traction bogies. If one traction bogie is isolated, the loco is still able to drive with half traction power.

2.11.3 Central electronics rack

- r 2113.01 i The central electronics rack (CEL) includes the processors FLG, HBB and STB. The central electronics rack 1 is mounted on the control cubicle 1. The central electronics rack 2 is mounted on the control cubicle 2

- r 2113.02 f In case of processor **HBB1 isolation** the following consequences will happen:

Cab 1 will be isolated and since the hotel load earth faulty relay is not monitored the hotel load must be isolated as well, cab change is necessary.

Failed functions:

- Miniature circuit breakers are not monitored
- Earth fault relay 415/110V is not monitored
- Auxiliary contact fuse 415/110V is not monitored

- r 2113.03 f In case of processor **HBB2 isolation** the following consequences will happen:

Cab 2 will be isolated, cab change is necessary.

Failed functions:

- Release of parking brake only manually on the pneumatic panel possible
- Regenerative brake not available
- The vigilance control shall be isolated manually (Message for the driver)
- Pan 1 not available

- The following pressure switches are not monitored:
 - Direct brake (forced by SW to avoid start/running interlock)
 - Pan 1 & 2
 - Flow indication
 - Low main reservoir
 - Brake feed pipe
 - Brake cylinder bogie 1 & bogie 2

r 2113.04 f

In case of processor **STB1 isolation** the following consequences will happen:

Cab 1 will be isolated and hotel load will be isolated as well, cab change is necessary.

Failed functions:

- Air dryer
- Hotel load
- Anti spin valve bogie 1 {282}
- Switch failure mode operation
- Switch simulation mode
- Switch bogie cut out

r 2113.05 f

In case of processor **STB2 isolation** the following consequences will happen:

Cab 2 will be isolated, cab change is necessary.

Failed functions:

- Monitoring traction MCB's (oil pump, converter/trafo blower)
- Overspeed input from HASLER 110% & 105%
- Speedometer alarm output {94.2}
- Earth fault relay BUR not monitored
- Fire alarm on the master loco, from a fire on the slave loco
- Vigilance inputs for buzzer

Note: If the STB2 is isolated on the slave loco and there is a fire detection, there is no indication on the master loco possible

There's no need to have a redundant speedometer alarm output because the speed is redundant available by the internal used speed signals from the converters (speed sensors). There's no need to have a redundant vigilance input for buzzer, because there's a vigilance control indicator.

- r 2113.06 f In case of processor **FLG1 isolation** , FLG2 takes over and the following consequences will happen:
- Failed functions:
- Angle transmitter TE/BE throttle in cab1 --> 2.10 Failure mode operation
 - Multiple operation via UIC train bus
 - Actual TE/BE meter
- r 2113.07 f In case of processor **FLG2 isolation** the following consequences will happen:
- Failed functions:
- Angle transmitter of TE/BE throttle in cab2 --> 2.10 Failure mode operation
 - Actual TE/BE meter
 - Pneumatic brake effort demand. Due to safety reasons, the regenerative brake will be not available (pressure automatic brake pipe is input to FLG2 only)
- r 2113.08 f In case of processor **DDA1 isolation** the following consequences will happen:
- Failed functions:
- Communication to diagnostic terminal in cab 1
- r 2113.09 f In case of processor **DDA2 isolation** the following consequences will happen:
- Failed functions:
- Communication to diagnostic terminal in cab 2
- r 2113.10 f In case of processor **DIA isolation** the following consequences will happen:
- Failed functions:
- No energy counter
 - No locomotive number
 - No DDS records

2.12 Protection concept

2.12.1 General

- n 2121.01 i The protection concept is based on the following principles:
1. Prevention of dangerous situations
 2. Prevention of damage
- n 2121.02 i There are two kinds of protections: Passive and active
- Passive protection means preventive proceedings, for example: Earthing conception, over voltage surge arrestor etc.
- Active protection means all protective actions if a danger situation occurs. Most of protective actions are handled by MCE.
- n 2121.03 i To guarantee the active protection, the MCE monitors a lot of input values, for example: Voltages, currents, temperatures, pressures and other signals.
- n 2121.04 i All protective function monitoring the traction circuits are listed in: Specification of ABB Protective Functions, 3EHP 541 526. Furthermore this document indicates also the limit values and describes the protective measures which shall be taken if they are exceeded.

2.12.2 Protective actions

- n 2122.01 i To prevent danger, the MCE has the following protection actions:
- n 2122.02 f **Protective shut-down:**
The following actions will happen:
1. Stop pulsing traction converter
 2. VCB is switched off (Pan will stay raised)
 3. MUB deenergises the DC-link and the converter contactors will open
 4. Master flow chart in disturbance node

Reasons for a protective shut-down:

- Vehicle-bus between SLG and ASC or NSC disturbed
- Gate unit power supply failure
- Faulty main converter contactors
- Plausibility checks failed in processors SLG, ASC, NSC
- Protection: Traction motor current, DC-Link voltage & current
- Protective actions --> 3EHP 541 526

n 2122.03 f

Disturbance with VCB off:

The following actions will happen:

1. Stop pulsing traction converter
2. VCB opens (Pan will remain raised, converter contactors are closed)
3. Master flow chart in disturbance node

Reasons for a disturbance with VCB off:

- Protective actions --> 3EHP 541 526
- Vehicle-bus or train-bus disturbance
- Disturbance node with VCB off from Master flow chart
- Disturbance node with VCB off from Sub flow charts
- Limit-monitoring of SLG1 or SLG2
- Emergency stop push button {06B,244}
- Harmonic filter contactor problems --> s 2335.02 f
- General: All faults, which causes an isolation of a subsystem

n 2122.04 f

Traction interlock:

The following actions will happen:

1. Ramp down the tractive/braking effort demand (approx. 100kN/s)
2. Stop pulsing traction converter (no traction or braking effort available)
3. Master flow chart in disturbance node without VCB off

Under the following circumstances the traction is interlocked:

- Vigilance emergency brake application --> n 2612.03 f
- Angle transmitter disturbance --> 2.10 Failure mode
- Protective actions --> 3EHP 541 526
- Pressure switch emergency brake {06A,269.1} --> s 2425.07 f
- Battery voltage too low, see --> n 2125.04 f
- Memotel 110% overspeed --> n 272.01 f
- Brake electronic failure --> n 2425.01 f

The interlock will be released, as soon as the reason of the traction interlock disappears and the driver moves the TE/BE throttle through position "0". The release of traction interlock needs always a manual handling (release never automatically).

n 2122.05 f

Start/Running interlock:

Start/Running interlock means, the TE demand will be set to zero with a ramp of approx. 100kN/s. The regenerative brake is still available.

Under the following circumstances the start/running is locked:

- Parking brake applied --> n 2424.02 f / v 2810.01 f
- Pneumatic Loco brake applied --> n 242.04 f / v 2812.02 f
- Automatic brake applied --> n 2423.04 f
- Main reservoir pressure --> n 2532.01 f
- Isolation cock brake pipe control system --> n 242.05 f / v 21262.02 f
- Fire Alarm Detection --> 262.02 f
- Emergency exhaust isolated {cock 06A, 237.3}

The interlock will be released, as soon as the reason of the start/running interlock disappears and the driver moves the TE/BE throttle through position "0". The release of start/running interlock needs always a manual handling (release never automatically).

2.12.3 Protection main power

n 2123.01 i

Reference document: 3EHP 541 526 'Specification of ABB protective functions'

2.12.3.1 Catenary (or line) voltage

n 21231.01 i

VCB off:

In case of catenary voltage not in the permitted range the VCB is switched-off. --> 3EHP 541 526, 5.1

n 21231.02 i

The traction power as a function of the catenary voltage is described in --> ALG engineering specification (protective characteristic 1a) 3EHL 420 622

2.12.3.2 Transformer

n 21232.01 f

The transformer is protected against overcurrent in primary and secondary windings --> 3EHP 541 526.

n 21232.02 f

MCB's of oil pumps and temperature of the transformer oil circuit are monitored.

A tripped MCB creates a priority 2 fault message.

n 21232.03 f

The transformer oil pressure is monitored by different pressure measurement --> 3EHP 541526, 5.8.

2.12.3.3 Main converter

- n 21233.01 f The protection of the converter shall be realised in 4 levels:
- 1) instant voltage limitation in the DC-link by the overvoltage protection unit (MUB) {01D,15.1}
 - 2) power reduction in case of increased converter-oil temperature --> 3EHP 541 526, 5.11
 - 3) traction interlock in case of ...
 - exceeded high oil-temperature --> 3EHP 541 526, 5.11
 - too low oil-pressure --> 3EHP 541 526, 5.10
 - 4) protective shut-down in case of ...
 - too high DC-link voltage
 - line- or traction converter overcurrent
 - converter contactor stuck on/stuck off
 - gate unit or gate unit power supply disturbed
 - over voltage protection unit (MUB) disturbed
 - ALG/SLG disturbed
 - 5) Battery volts < 86V leads to protective shut down of traction converter. --> 2125.04
- n 21233.02 f The DC-link voltage is dynamically set. The DC-link voltage is a function of vehicle speed. This DC-link voltage characteristic is described in --> 3EHL 420 622. A software parameter will activate this function.
- n 21233.03 i **Over voltage protection unit (MUB):**
The over voltage protection unit (MUB), which is controlled by the ALG shall prevent the DC-link from over voltage. In case of a protective shut-down the DC-link will be discharged through the MUB in a fast way. The protective measures described below are necessary to prevent damages of the MUB itself.
- n 21233.04 f The MUB shall never be used to discharge the DC-link if neither the VCB nor the converter contactors were opened.
- n 21233.05 f The temperature of the MUB are calculated by the ALG. In case of over temperature a protective shut down takes place. The over temperature limit is set in such a way that a protective shut down still can take place without any danger of damage to the MUB.

2.12.3.4 Traction motor

- n 21234.01 i The traction motors are protected from against overcurrent by the main converter. The protective measures are implemented in the ALG processor.
- n 21235.02 i The traction motors are protected against overspeed and over temperature --> 3EHP 541 526, 5.6 & 5.7.

2.12.4 Protection auxiliary systems

2.12.4.1 Auxiliary converter (BUR) / Single phase

- n 21241.01 f The auxiliary converters are protected from the following failures:
- DC-link voltage auxiliary converter too high
 - DC-link current auxiliary converter too high
 - no DC-link voltage detected in spite of enabled rectifier (e.g. fuse {40} defective)
 - inverter disturbed
 - output current inverter too high
 - supply frequency out of range ($\pm 10\%$)
 - temperature inside converter too high (enabling/disabling this function)
- n 21241.02 f The control software of the auxiliary converter generates for each disturbance mentioned in --> 21241.01 a signal to the vehicle control software. This signals are specified in document 3EHE 620 298
- n 21241.03 f The protective functions of the auxiliary converters trips the VCB for all failures mentioned in --> 21241.01. Should it prove impossible to clear the failure, the BUR loads are redistributed --> 2.5.2.2.
- n 21241.04 f The current in the auxiliary winding of the transformer is monitored --> 3EHP 541 526, 5.5.
- n 21241.05 f An earth fault in the auxiliary winding is detected --> 3EHP 541 526, 5.17
- n 21241.06 f Earth fault 415V single phase is detected --> 3EHP 541 526, 5.18

2.12.4.2 Hotel Load

- n 21242.01 f The current in the hotel load winding is monitored --> 3EHP 541 526, 5.4
- n 21242.02 f An earth fault in the hotel load winding is detected --> 3EHP 541 526, 5.16

2.12.4.3 Oil pumps and fans (traction motors, oil coolers)

- n 21243.01 f The transformer oil pumps {62} and converter oil pumps {63} are monitored by:
- the status of the MCB's {62.1} & {63.1}
 - the oil pressure of the converter
- > 3EHP 541 526, 5.8 & 5.10
- n 21243.02 f The traction motor fans {53} are monitored by the status of the MCBs {53.1}.
- n 21243.03 f The oil cooler fans {59} are supervised by monitoring the status of the MCBs {59.1}.
- n 21243.04 f In case of a tripped MCB {53.1} or {59.1} a fault message priority 2 is generated.

2.12.5 Protection Battery

- n 2125.01 f The control circuits will be switched off, if the cab is activated and the pantograph is lowered longer than 10 minutes (inhibited in simulation mode)
- n 2125.02 f In the event of fault in the battery charger , a fault message with priority 2 will be indicated on display in the driver's cab. A fault of the battery charger is detected if the charging current < 10A. This value shall be settable during commissioning
- n 2125.03 f If the battery voltage drops below 92V more than 30 sec (energy stored in battery sufficient for running loco another 30 minutes), then a fault message/ warning (priority 2) will be indicated on the diagnostic display.
- n 2125.04 f If the battery voltage drops to 86V (battery sufficient for 5 minutes), interlock will ensure correct switch off procedure --> n 2122.04 f. A fault message with priority 1 will be indicated on the diagnostic display.
- n 2125.05 f If the battery voltage drops below 82V, then the loco will shut-down and all control circuits shall be switched off {Contactor control circuits, 126} under all operating conditions.
- n 2125.06 f Control circuit earth fault is monitored --> 3EHP 541 526
- n 2125.07 f The circuit breaker input battery charger {04A,100} is monitored by processor BUR3 or 2. If the MCB trips a priority 2 fault message will be indicated on the display.

2.12.6 Protection Control Electronic

2.12.6.1 Mutual supervision of processors

- n 21261.01 f All the distributed processors connected to the vehicle bus send a check signal to the vehicle control unit (FLG1, i.e. the master processor). A failure of a processor or of the communication via the vehicle bus is detected by the FLG since the corresponding check signal cannot be received. In case of failure the VCB is tripped.
- n 21261.02 f Similarly the FLG sends a check signal to all the bus stations. Failure of the FLG processor or the communication via the vehicle bus is detected by the bus stations since the corresponding check signal cannot be received. If the check signal disappears only briefly, the protection function trips the VCB; if it disappears for a longer period (>30 sec), the corresponding processor is isolated --> 2.9. Disturbances
- n 21261.03 f The function of the diagnostic terminal is not supervised by the MCE. Self test performed. Display generates a number of text messages to check operation of the display.

2.12.6.2 Monitoring of the communication on the train bus

- v 21262.01 f The train bus in a multiple unit is supervised in a similar manner by monitoring the corresponding check signals slave -> master and master -> slave.
- v 21262.02 f In case of a train bus disturbance detected on the master, then the master loco generates a fault message priority 1 without tripping the VCB. Protection for slave loco see ref. s 283.02 f.

2.12.6.3 Monitoring of VCB

- n 21263.02 f The VCB is monitored by the MCE on its correct position --> 225.08
- n 21263.03 f The following states of the auxiliary contacts are detected:

Stuck-off

If a contact remains off 1s after the on-command was set, stuck-off will be detected and the on-command will be reset.

Stuck-on

If a contact remains on 0.5s after the on-command was reset, stuck-on will be detected.

2.12.6.4 Monitoring of converter equipment

- n 21264.01 f The pressure of the DC-link capacitor bank is monitored
--> 3EHP 541 526, 5.14
- n 21264.02 f The gate unit power supply {16B,219} is monitored by the converter electronics. In case of failure a protective shut-down of the converter is performed.

2.12.6.5 Monitoring of correct software type

- n 21265.01 f To avoid a mismatch between the software and the vehicle, like software of WAP-5 on WAG-9 loco or software of WAG-9 on WAP-5 loco, one special binary input signal is provided on each CEL-rack {17B}. In case the signal of the vehicle mismatches to the software a priority 1 fault message is generated and the pan is locked.

2.12.6.6 Monitoring of CEL temperature

- n 21266.01 f The CEL temperature is monitored by the thermostat {08B, 211.1}. An over temperature generates a diagnostic data set (DDS).

2.12.6.7 Monitoring of traction motor speed sensors

- n 21267.01 f The sensors are monitored by the converter control electronics. A defective sensor shall not cause the isolation of the corresponding bogie.

2.12.6.8 Monitoring of filter circuit

- n 21267.02 f An earth fault in the filter circuit is detected --> 3EHP 541 526, 5.19
The filter circuit is protected against overcurrent --> 3EHP 541 526, 5.3.

Appendix A: List of changes to software specification

Version	Statement	Text (All changes are highlighted)
C	1.5.	Corrected document names: Tractive Effort Diagram (WAP-5) 3EHP 510 115 Tractive Effort Diagram (WAG-9) 3EHP 510 116 New documents: Braking Effort Diagram (WAP-5) HBTB 490 730 Braking Effort Diagram (WAG-9) HBTB 490 731
	n 213.02 f	Turn on condition for MCE, require Uprim < 17.5kV.....
	n 223.021	Change to n 223.02 f
	n 2242.10 f	Each pan is monitored by a pressure switch {05A, 130.4}. VCB open: After the driver's wish to raise the pan, the driver will be informed by a message on the diagnosis display, that the pan is raising. As long as the air pressure of the pan is not ok, the VCB will be disabled. If the pantograph air pressure will not be ok after 20 s, a fault message will be displayed. VCB closed: In case of
	n 225.04 f	To close the VCB in driving mode, the HOLD coil of VCB {05B,5} shall be energised and the ON coil will get a turn-on pulse by 1 second. In cooling mode the ON pulse is generated by a time relay. The CEL closes the VCB under the following conditions: - - -
	n 225.04 f	Our opinion is, we do not include the required part from RDSO " VCB closes only when throttle is set at "0" position because, 1. The idea of this function, we have already done by start/running interlock, if the throttle is not in "0" position, the loco can not move. 2. The point when the loco can move is in this technology a few steps later than in old units, because after the VCB is closed, both DC link have to be charged, Line converter has to start pulsing and the traction motors will get magnetised.
	n 225.06 f	The CEL shall switch-off the VCB (together with a corresponding disturbance message) by interruption of the VCB HOLD line and overwrite the driver's command "VCB on" with "VCB off" by deenergising the auxiliary contactor VCB {05B,136.4} in the following cases: - Catenary voltage is out of range --> 3EHP 541 526 - Cause of VCB tripping due to disturbance--> n 2122.03 f - Emergency stop push button {06B,244} pressed (hardware function) - Primary overcurrent indication/isolation provided by auxiliary contact {05B, 78}
	n 231.02 f	3. Push the VCB switch {05B,134} to Pos. "On" (VCB will close) 4. The driver has to wait until the main compressor has filled up the main reservoir 5. Operate the reverser {08C,140} from position neutral to forward or reverse. If the main reservoir is not filled up, a fault message 'Low main reservoir pressure' will be displayed.

Version	Statement	Text (All changes are highlighted)
	s 2335.02 f	<p>In all cases, which will cause an isolation of subsystem harmonic filter, it creates before a VCB off with disturbance. contactor filter on/off {8.1} stuck off:</p> <ul style="list-style-type: none"> - VCB off with disturbance - priority 1 fault message --> Isolation of harmonic filter 295.01 <p>contactor filter adaptation {8.2} stuck off:</p> <ul style="list-style-type: none"> - VCB off with disturbance - priority 1 fault message, in normal 2 bogie operation --> Isolation of harmonic filter 295.01 <p>stuck on:</p> <ul style="list-style-type: none"> - VCB off with disturbance - priority 1 fault message, if isolation of one bogie is required --> Isolation of harmonic filter 295.01 <p>contactor filter discharging {8.41} stuck off:</p> <ul style="list-style-type: none"> - priority 1 fault message - the filter capacitor {01A, 8.4} remains charged --> Isolation of harmonic filter 295.01 <p>stuck on:</p> <ul style="list-style-type: none"> - VCB off with disturbance - priority 1 fault message - contactor filter on/off {8.1} must stay off --> Isolation of harmonic filter 295.01 <p>contactor converter pre-charging {12.3} stuck off:</p> <ul style="list-style-type: none"> - - <p>stuck on:</p> <ul style="list-style-type: none"> - VCB off, shut-down, priority 1 fault message, - Isolation of subsystem main power
	s 242.02 f	If the control electronics of the brake equipment is not working, then a priority 1 fault message is displayed and a traction interlock is provided . (Brake control failed means: MCE input 'Brake electronic o.k.' = 0).
	n 2421.02 f	Last part: 'Pneumatic brake effort demand' {Pn 55} shall be 0V .
	n 2421.04 i	Change to s 2421.04 i
	n 2425.01 f	<ul style="list-style-type: none"> - Emergency brake application by overspeed monitoring of system MEMOTEL. Input... --> see also protective action n 2122.04 f - Brake electronic failure; Input; --> see also protective action n 2122.04 f <p>Last paragraph, last sentence: The MCE detects that emergency brakes are applied and accordingly sets TE/BE demand to zero.</p>
	n 243.03 f	The adhesion control may activate....
	n 251.01i	The hotel load is supplied by an auxiliary winding of the main transformer. The nominal ratings are: 750 VAC, 50Hz, 945 KVA .
	n 2512.04 f	If the driver wish's to close the hotel load contactor and the main reservoir is not filled up, the contactor will not close as long as the pressure is not ok. A fault message 'Low main reservoir pressure' will be displayed.

Version	Statement	Text (All changes are highlighted)
	s 2513.02 f	stuck off: - reset of hotel-load contactor command - priority 2 fault message is generated
	n 2536.02 f	1. Ramp down the auxiliary inverter (BUR3) frequency from 50Hz to 0Hz in 5 sec. At the same time release the air with opening of unloading valve {06D,273.3} (= switch on the valve coil). Failure monitoring of oil flow/pressure & battery voltage shall be suppressed during ramp up/down.
	2.6.2	New numbers
	n 262.02 f	Fire in machine room is detected, if the MCE input 'Fire alarm' and the MCE input 'Fire warning' is activated. This will cause the following actions:
	n 262.03 f	Smoke in machine room is detected, either the MCE input 'Fire alarm' or the MCE input 'Fire warning' is activated. This will cause a priority 2 fault message.
	n 262.05 f	Last Paragraph is to be deleted. The detection of a failed fire detection unit, MCE input 'Failure fire detection equipment' will create a priority 2 fault message (fault without VCB off). Afterwards, there is no limitation to drive the loco.
	n 272.01 f	3. "Speed 110%" - traction interlock - emergency brake application (hardwired)- priority 1 fault message "Overspeed"
	n 2742.03 i	Change to n 2742.03 f
	n 277.02 i	During crossing a neutral section the VCB is opened. The Pantograph may or may not be lowered.
	n 278.02 f	After 50'000'000 kWh, the counter....
	v 284.01 f	In multiple unit the two most distant pantographs shall be used. Settable during commissioning (behaviour to be checked during trials). The UIC connections establish the free end of the locomotive.
	s,v 285.03 f	If a fault with VCB off on the slave loco occurs, the VCB will close automatically after pressing the fault acknowledge push button on the master loco (if the fault has disappeared). The VCB on the master loco will remain closed.
	s,v 285.04 f	If a fault with VCB off on the master loco occurs, the VCB will open on the slave loco as well, because of synchronising the auxiliary relays of VCB {05B,136.4} on both locos.
	s 287.05 f	Hotel load supply in multiple operation is only via the slave locomotive possible. If not possible to energise the hotel load contactor on the slave loco, a corresponding fault message is displayed on the master loco.
	v 2810.03 f	New paragraph: If the master loco has the parking brake not applied before coupling to a slave loco, the master loco will apply the parking brake, because on the slave loco is the parking brake applied.
	v 2815.02 f	Fire in machine room is detected, if the MCE input 'Fire alarm' and the MCE input 'Fire warning' is activated. This will cause the following actions on the slave loco:
	s 292.05 f	New paragraph: If the back-up battery for the non-volatile memory of the diagnosis processor is nearly empty, the driver shall be informed by a display message. To prevent loss of diagnosis data, the battery shall be exchanged within a few days.

Version	Statement	Text (All changes are highlighted)
	r 2113.06 f	In case of processor FLG1 isolation , FLG2 takes over and the following consequences will happen: Failed functions: - Angle transmitter TE/BE throttle in cab1 --> 2.10 Failure mode operation - Multiple operation via UIC train bus - Actual TE/BE meter
	r 2113.07 f	In case of processor FLG2 isolation Failed functions: - Angle transmitter of TE/BE throttle in cab 2 failed. --> 2.10 Failure mode operation - Actual TE/BE meter
	n 2122.03 f	Reasons for a disturbance with VCB off: - Harmonic filter contactor problems --> s 2335.02 f - General: All faults, which causes an isolation of a subsystem
	n 2122.04 f	Under the following circumstances the traction is interlocked: - Memotel 110% overspeed --> n 272.01 f - Brake electronic failure --> n 2425.01 f Last paragraph: The interlock will be released, as soon as the reason of the traction interlock disappears and....
	n 2122.05 f	Append this Start/Running interlock conditions: - Fire Alarm Detection --> 262.02 f New Start/Running interlock conditions - Emergency exhaust isolated {cock 06A, 237.3}
D	n 2242.10f	If the pantograph air pressure will not be ok after 35s ,
	n 222.02f	Both cab activated means, on two cab's the key switch is not in Pos."0". If one key is in Pos. "D" in a cab and a second key will be tried to set in Pos. "D" on the second cab this won't be accepted by hardware. Shut down and disturbance message was deleted
	n 223.03 f	During shut down of loco prevention must be made from setting-up the cooling mode. After shut down (DC-link deenergised) changing in cooling mode must be possibel with key switch in Pos. "C" without waiting 10 minutes.
	n 258.02 f	Floating voltage: 1.38V/Cell (111V, +/-1.35V)
	n 258.04 f	There are 3 redundant measurements to control the 110 V supply (BUR2&3): -Battery voltage direct measured by a analog input to BUR 2&3 -Battery current (charge/discharge) measured by 2 current sensors for BUR 2&3 -110 V supply current (current to feed the battery and the 110 V equipment) measured by 2 current sensors for BUR 2&3 The following parameters are regulated through the DC-link control (BUR 2&3): -The supply current is limited to max. 110 A -The battery charging current is limited to max. 40 A -The battery voltage is regulated with a maximum current of 40 A up to 111 V as long there is no overcurrent in supply current (Isupply > 110 A) or in battery charging current (Ibatt > 40 A).
	n 2521.02 i	BUR1: Scavenge blowers{02Z,55} (Scavenge blowers not dependent on bogies)
	n 2521.02 i	BUR2: Scavenge blowers {02Z,55} (Scavenge blowers not dependent on bogies)

Version	Statement	Text (All changes are highlighted)
	n 2521.05 f	BUR1 & 2: Step1: 34Hz , Step2: 37Hz , Step3: 50Hz (BUR1 & 2 ventilation frequency was increased to approve the efficiency of the scavenge filter system)
	v 288.03 f	The closed pressure switch 7.5 kg/cm² {06E, 172.3} or the switch 5.6 kg/cm² {06E, 269.4} on the master or slave loco causes all compressors of multiple unit to run simultaneously.
	v 288.04 f	This paragraph was deleted and integrated in paragraph v 288.03f
	n 2334.03 f	The contactor shall be opened - 20 seconds after the converter stopped pulsing or - if the VCB is switched off
	n 2411.05 f	Changing of travel direction is possible only if speed is below 2 km/h, and TE/BE is '0'. If driving direction and reverser position are not equal a start/running interlock is generated.
	n 2415.02 f	To activate speed control, the loco-speed shall be more than 5 km/h and TE/BE demand from throttle must be greater than zero.
	n 2425.03 f	All emergency brake application sensed by the pressure switch {06A, 269.1} are suppressed, if the speed is below 2 km/h. (This is used in case of start/running with the train at a hill).
	s 2513.03 f	If the oil pressure in one transformer oil circuit is too low, (i.e. oil pump failed) the hotelload contactor is inhibited.
	s 2513.04 f	If the pressure in main reservoir is less than 5.6 kg/cm², hotelload is switched off.
	n 2535.03 f	2. Ramp down the frequency of the auxiliary inverter (BUR3) from 50Hz to 0Hz in 15 sec. 4. Ramp up the BUR frequency from 0Hz to 50Hz in 2 sec.
	n 2536.01 f	2. Ramp down the frequency of the auxiliary inverter (BUR3) from 50Hz to 0Hz in 15 sec. 4. Ramp up the BUR frequency from 0Hz to 50Hz in 2 sec.
	n 2536.02 f	1. Ramp down the auxiliary inverter (BUR3) frequency from 50Hz to 0Hz in 15 sec. 3. Ramp up the BUR frequency from 0Hz to 50Hz in 2 sec.
	n 2562.02 f	Temperature of the transformer oil --> Protective functions 3EHP 541526, 5.9
	n 2562.03 f	-Temperature of the transformer oil --> Protective functions 3EHP 541526, 5.9 -Actual speed < 30 km/h (hysteresis 5 km/h) and TE/BE > 70% (hysteresis 10%) of TE/BE max. 30 sec. ventilation afterwards if TE/BE was > 70%. --> Protective functions 3EHP 541526, 5.9

Version	Statement	Text (All changes are highlighted)
	n 2562.04 f	<p>- Temperature of transformer oil --> Protective functions 3EHP 541526, 5.9</p> <p>- Actual speed > 30 km/h (hysteresis 5 km/h) and TE/BE > 70% (hysteresis 10%) of TE/BE max. 30 sec. ventilation afterwards if TE/BE was > 70%.</p> <p>--> Protective functions 3EHP 541526, 5.9</p> <p>- Step 3 is 30 sec turn-off delayed ----> deleted</p>
	s 294.02 f	Usually, the rotary switch is in position "NORM". It is only allowed to cut out a bogie, if the MCE is switched off .
	n 21263.03 f	Stuck-on If a contact remains on 0.5s after the on-command was reset, stuck-on will be detected.
	n 2562.05 f	Frequencies of the three steps (to be finally set during trials) Step 1: 24 Hz Step 2: 37 Hz Step 3: 50 Hz Step3A: 42Hz
	n 2411.05 f	Changing of travel direction is possible only if speed is below 2 km/h, and TE/BE is '0'. If driving direction and reverser position are not equal a start/running interlock is generated.
	1.5	Diagnosis: Screen structure and operation 3EHP 541 783
	n 242.05 f	The isolation cock brake pipe control system {06A, 293.2} shall be in open position on the leading loco of a train. The closed cock on a leading loco causes a start/running interlock.
	n 242.06 f	To avoid feeding of the brake pipe from a banking loco, the isolation cock brake pipe control system shall be in closed position on a loco operating in banking mode. The open cock on a banking loco causes a start/running interlock.
E	--	Corresponds to software release 1.20 (December 99)
	1.4	MCB Miniature circuit breaker
	n 225.05 f	There is no explicit delay by software, the delay is the result of task switching and delivering data by the MVB.
	N 2331.01 f	<p>- Main circuit breaker closed (by driver)</p> <p>- Filter contactor on/off {01A/05H, 8.1} opens</p> <p>- Contactor filter discharging closed (by MCE)</p> <p>- Contactor filter adaptation in correct position ----> 2334.04</p> <p>2. The driver selects the travel direction by ...</p> <p>.....</p> <p>10. Filter contactor on/off {01A/05H, 8.1} closes</p> <p>- Contactor filter adaptation in correct position</p> <p>--> 2334.04</p> <p>11. Line- and drive-converter</p>

Version	Statement	Text (All changes are highlighted)
	n 2414.01 f	The ramps are different for BoBo and CoCo.
	n 2416.01 f	The max. acceleration is limited to: WAP-5: 0.5m/s ² ; 0.25 m/s² (normal mode ; shunting mode) WAG-9: 0.25m/s ² ; 0.125 m/s²;(normal mode ; shunting mode)
	n 2419.02 f	New values: 3.5% (old values: 5%)
	n 2425.01 f	Emergency brake application on a coach Pressure switch-emergency brake {06A, 269.1} ACP = Alarm chain pulling) no directly brake application, only buzzer activation inside the cab (detection by air flow sensor and brake pipe pressure)
	n 246.01 f	The shunting mode ...
	n 251.01 i	(BoBo only)
	n 2521.02 i	BUR1 supply: Oil cooler blower bogie 1 {02Z,59} Oil cooler blower bogie 2 {02Z,59}
	n 2521.03 i	BUR2 supply: Traction motor blower bogie 1 {02Z,53} Traction motor blower bogie 2 {02Z,53} Transformer oil pump 1 & 2 {02Z,62} Traction converter oil pump 1 & 2 {02Z,63}
	n 2521.04 i	BUR3 supply: Scavenge blowers {02Z,55} Main compressor 1 & 2 {02Z,47} Battery charger {02Z,107}
	n 2521.05 f	Step3A: 42 32/37 Hz,
	r 2522.03 f	(42 32/37 Hz)
	r 2522.04 f	(42 32/37 Hz)
	r 2522.05 f	(42 32/37 Hz)
	n 2531.04 f	The compressors, oil pumps and the battery charger are supplied by the same auxiliary converter (normal operation mode: BUR3) with constant frequency (50 Hz). In case BUR3 is isolated, BUR2 will supply its loads with 50 Hz.
	n 2535.03 f	Real values for programming: 0Hz corresponds to < 20 Hz 50 Hz corresponds to > 45 Hz
	n 2536.01 f	...(BUR3) from 50Hz to 0Hz with a rate of 2 Hz/sec. At the same time..... 4. Ramp up the BUR frequency from 0Hz to 50Hz with a rate of 5 Hz/sec.
	n 2536.02 f	...(BUR3) from 50Hz to 0Hz with a rate of 2 Hz/sec. At the same time..... 3. Ramp up the BUR frequency from 0Hz to 50Hz with a rate of 5 Hz/sec.

Version	Statement	Text (All changes are highlighted)
	n 2561.03 i	The ventilation for the traction motors and oil cooling unit is not bogie selective supplied by Auxiliary converter 2521.02-03
	n 2562.05 f	Step3A: 42 32/37 Hz
	n 2571.01 i	The oil pumps (2 oil pumps for the transformer {02Z,62} and for each main converter one oil pump {02Z,63}) work continuously during operation of the auxiliary converter (BUR31).
	n 278.01 f	The energy counters are displayed in kWh (kilo Watt hours) on the diagnostic screen. Two values are displayed: energy consumption and regenerated energy. These values are stored in the battery buffered data base of processor DIA1. That means, on the screen the accumulated values are displayed.
	r 2113.07 f	(pressure automatic brake pipe is input to FLG2 only)
	n 21241.01 f	- supply frequency out of range ($\pm 3\%$ or more) - temperature inside converter too high (enabling / disabling this function)
F	--	Updates for release F are requested by Bombardier Transportation India due to reviewing the documents
	n 2231.01 f	- Battery volt meter {12A,116} - cock for assistant driver's emergency brake {Pn 113} - cab and instrument lighting {324.21, 324.22, 337} - cab, desk lighting and handlamp {324, 324.21, 324.22, 337} - windscreen wiper - cab venting and heating {03A,65.6} - diagnostic terminal {435} - marker lights red and white switches {316.11, 316.12} - crew fans {69.7}
	n 2414.01 f	Increase and decrease of TE/BE demand will be limited to 20-kN/sec a default value . This value shall be setable during commissioning. (Note: A new ramp will have an influence to the speed and acceleration control). The ramps are different for BoBo and CoCo and implemented using parameters .
	n 2414.02 i	Parameters for above ramps are implemented in FLG, Cluster 53
	n 2416.01 f	The max. acceleration is limited to (example) :
	n 2416.02 f	The max. deceleration is limited to (example) :
	n 2416.06 i	Parameters for above values are implemented in FLG, Cluster 53. Actual values can be different to above examples.
	n 243.04 f	TE/BE demand / TE/BE actual – TE/BE actual / TE/BE demand
	n 2521.05 f	In normal operation mode the auxiliary inverter frequency is: BUR1 & 2 : Step1: 24Hz, Step2: 37Hz, Step3: 50Hz, Step3A: 32/37 Hz, BUR2: 47/50 Hz BUR3 50Hz

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Version	Statement	Text (All changes are highlighted)
	n 2521.06 f	4 new contactors are added due to BUR redistribution of load. Software does not manage these contactors directly (hardwired). Following table gives an overview concerning these contactors: [Table]
	n 2522.03 f	4 new contactors are added due to BUR redistribution of load. Software does not manage these contactors directly (hardwired). Following table gives an overview concerning these contactors: [Table]
	n 2522.03 f	In this configuration, the frequency of BUR2 is limited to Step3A (32 /37 Hz).
	n 2522.04 f	4 new contactors are added due to BUR redistribution of load. Software does not manage these contactors directly (hardwired). Following table gives an overview concerning these contactors: [Table]
	n 2522.04 f	In this configuration, the frequency of BUR1 is limited to Step3A (32 /37 Hz).
	n 2522.05 f	4 new contactors are added due to BUR redistribution of load. Software does not manage these contactors directly (hardwired). Following table gives an overview concerning these contactors: [Table]
	n 2522.05 f	In this configuration, the frequency of BUR1 is limited to Step3A (32 /37 Hz).
	n 2531.03 f	2. The pressure switch "main compressor 7.5 8.5 kg/cm ² " {06E,172.3} will be cut in at 7.5 8.5 kg/cm ² and cut out at 40 10.5 kg/cm ²
	n 2532.01 f	The pressure switch "main compressor 8 kg/cm ² " {06E,172.4 172.2 } closes... The pressure switch "main compressor 7.5 8.5 kg/cm ² " {06E,172.3} closes when pressure falls below 7.5 8.5 kg/cm ² . It causes both compressors to run simultaneously until pressure reaches 40 10.5 kg/cm ² . Both compressors shall continue until pressure reaches 40 10.5 kg/cm ² , but...
	n 2535.01 f	No more valid because both compressors run simultaneously because the setting of the pressure switches has been changed (i.e. the pressure switch which was earlier set to 7.5 kg/cm² is now set to 8.5 kg/cm²). Both compressors start now before the command for 1 compressor is executed. But in software, the logic for one main compressor remains untouched.
	n2535.03 f; n2536.01f ; n2536.02 f	Ramp up/down the BUR frequency from 0Hz to 50Hz/50 Hz to 0 Hz with a rate of 5 Hz/sec
	n 2562.01 f	The ventilation of traction motor and oil cooling circuits is
	n 2562.05 f	Step3A: 32 24 /37Hz
	n 2563.01f	In case of an auxiliary converter (BUR1 or 2) isolation, ventilation step 3A (42 37 Hz) will replace step3.

Version	Statement	Text (All changes are highlighted)
	s 2563.01 f	... work continuously during operation of the auxiliary converter (BUR12).
	v 288.03 f	The closed pressure switch 7.5 8.5 kg/cm ² {06E, 172.3} or the ...
	v 2814.01 f	... global command (loco-independant) (only valid for the loco which has slip/slide problems) .
	n 291.03 d	Isf a subsystem is isolated, all faults and signals...
	s 295.01 f	... the maximum loco speed shall be limited to $v_{max} = 40$ km/h TE shall be limited to 0 kN.
	n 2102.03 f	...same as usual (20 kN/s).
	r 2113.10 f	In case of processor DIA isolation the following consequences will happen: Failed functions: - No energy counter - No locomotive number - No DDS records
	n 21241.01 f	supply frequency out of range ($\pm 3\%$ or more 10%)

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