BUCHER
hydraulics

MOBILE

EMDAGxxxxxxxxx

MOBILE DCU
MOBILE PSU
MOBILE DCU PSU
MOBILE DCU S _____

Reference manual EN

300-I-9052004-EN-04/09.2023

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1 About this document

Danger!

The device is a source of danger which may lead to death or severe injury of persons.

To protect yourself and others against these dangers, observe the safety instructions in the hardware manual for the MOBILE before switching on the controller.

The hardware manual has been stored in electronic form on the data carrier supplied with the MOBILE.

Target group

This documentation addresses to all persons who want to parameterise, configure, and diagnose the MOBILE.

Information regarding the validity

The information in this documentation is valid for the following hardware and firmware combinations:

Product series	**Hardware** (Type designation)	**Firmware** (Designation)	**As of firmware version**
MOBILE DCU	EMDAG2xxxxxxxx	EMDAFFEAAxxxxxxx	R6.3
MOBILE PSU	EMDAG3xxxxxxxx	EMDAFFEBAxxxxxxx	R6.3
MOBILE DCU PSU	EMDAG4xxxxxxxx	EMDAFFEBAxxxxxxx	R6.3
MOBILE DCU S	EMDAG5xxxxxx0x	EMDAFFEABxxxxxxx	R6.3

Screenshots/application examples

All screenshots provided in this documentation are application examples. Depending on the firmware of the MOBILE and software version of the installed engineering tool ("MOBILE Engineer" or "MOBILE Starter"), the screenshots in this documentation may differ from the screens.

Document history

Version		Description
4.0	09.2023	Adaptation to firmware R6.4
3.0	07.2021	Rebranding to Bucher Hydraulics AG
2.1	03.2021	Adaptation to firmware R6.3
2.0	04.2019	Adaptation to firmware R6.1
1.2	08.2014	Adaptation to firmware R5.2
1.1	05.2014	Adaptation to firmware R5.0
1.0	11.2013	First edition

Tip!

Information and tools for MOBILE can be found on the Internet: www.bucherdrives.com

1.1 Conventions used

This documentation uses the following conventions to distinguish between different types of information:

Type of information	Writing	Examples/notes
Numeric notation		
Decimal separator	Point	The decimal point is always used. Example: 1234.56
Hexadecimal number	0x	For hexadecimal numbers, the "0x" prefix is used. Example: 0x60F4
Binary number	0b	For binary numbers, the "0b" prefix is used. Example: 0b00010111
Text		
Version information	Blue text colour	All information that only applies to or as of a certain firmware version of the drive controller is marked accordingly in this documentation. Example: This function extension is available as of firmware version V3.0!
Program name	» «	The Bucher PC software "MOBILE Engineer"...
Window	*Italics*	The *Message window*... / the dialog box *Options*...
Variable identifiers		By setting *bEnable* to TRUE...
Control element	**Bold**	The **OK** button.../ The **Copy** command.../ The **Properties** tab.../ The **Name** input field...
Sequence of menu commands		If several commands are required in succession for executing a function, the individual commands are separated by an arrow. Select the command **File→Open** to...
Shortcut	**<bold>**	Press **<F1>** to open the online help.
		If a key combination is required for a command, a "+" is inserted between the key identifiers: Use **<Shift>+<ESC>**...

Program code	`Courier`	`IF var1 < var2 THEN`
		`  a = a + 1`
		`  END IF`

Keyword	**`Courier bold`**	
Hyperlink	underlined	Optically highlighted reference to another topic. It is activated with a mouse-click in this online documentation.
Symbols		
Page reference	(📖 8)	Optically highlighted reference to another page. It is activated with a mouse-click in this online documentation.
Step-by-step instructions		Step-by-step instructions are indicated by a pictograph.

All information that only applies to or from a certain firmware version of the inverter is marked accordingly in this documentation.

1.2 Terminology used & abbreviations

Abbreviation	Term	Meaning
APPC	Application Controller	The Application Controller serves as an interface between the Motor Controller and the vehicle control system. For this purpose, it provides two CAN interfaces: The "Public CAN" for the connection to the vehicle bus and the "Private CAN" for the communication with the Motor Controller. While the Motor Controller always uses the same firmware, the APPC firmware can be replaced by customized firmware.
ASM	Async. motor	
CAN	Controller Area Network	CAN is an asynchronous, serial fieldbus system.
	CANopen	CANopen® is a CAN-based communication protocol. CANopen® is a registered community trade mark of the CiA® (CAN in Automation e. V.) CAN user organisation.
DCC	DC/DC Controller (SW module)	This firmware module includes the control of the on-board converter (insulating DC/DC converter).
DCU	Drive Control Unit	Inverter
DLC	DC-link controller	This firmware module includes the DC bus control. Based on the measured DC-bus voltage, it corrects the setpoints of the motors and onboard converters in order to control the DC-bus voltage within a defined range to ensure a stable operation.
	Engineering tool	Software solution for easy engineering in all project phases.
	Engineering PC	The Engineering PC and the installed Engineering tools serve to configure and parameterise the system.
FDB	Feedback (SW module)	The firmware module includes the functions of the motor feedback (resolver).
HV	High Voltage	Voltage supply system in vehicles with high voltage (approx. > 50 V) where a protection against accidental contact is required.
	Index	For the purpose of addressing, each object is provided with a unique index. In this documentation the index is represented as a hexadecimal value and is identified by a prefixed "0x", e.g. "0x1000".
INV	Inverter (SW module)	This firmware module includes the functions of the inverter and ensures that it operates correctly.
TRM15	Terminal 15	Switching voltage of the 12-V or 24-V on-board supply system for switching on and off the device.
TRM30	Terminal 30	Permanently applied supply voltage of the 12-V or 24-V on-board supply system.
TRM31	Terminal 31	Negative pole of the 12-V or 24-V on-board supply system (vehicle mass).
	Configuration	This comprises all data and settings required for a correct operation: • The firmware of the Application Controller • The firmware of the Motor Controller • All parameter sets Excepted from a configuration are the bootloader and manufacturing data.
	Default setting	This setting is the default factory setting of the device.
LV	Low Voltage	Voltage supply system in vehicles with low voltage (approx. < 50 V) where no protection against accidental contact is required.

Abbreviation	Term	Meaning
MC	Motor Controller (DSP)	Digital signal processor which takes over the control of the motors or DC/DC actuating drives. This Controller is optimised to max. real-time capability.
MCT	Motor Controller (SW module)	This firmware module controls the connected motor so that the received speed or torque setpoint will be reached at the motor shaft.
MOBILE	MOBILE drives	Bucher portfolio for MOBILE frequency inverters
MOD	Modulator (SW submodule)	Pulse width modulator for generating an output voltage at the inverter output.
NMT	Network Management Telegram	Communication object (CAN telegram) for transmitting CAN-relevant control information to some or all nodes of the CAN network.
	Object	"Container" for one or more parameters with which you can parameterise or monitor the MOBILE.
PDO	Process Data Object	Communication object (CAN telegram) for the transmission of process data.
PSM	Permanent-magnet synchronous motor	
PSU	Power Supply Unit	DC/DC converter
QSP	Quickstop	Quick stop
SCD	Scheduler (SW module)	This firmware module includes the "Task Scheduler" which is responsible for the exactly timed calls of the tasks required for the control.
SDO	Service Data Object	Communication object (CAN telegram), the internal structure of which allows for transfer of great data volume or the writing and reading of single parameters (CAN objects).
SLVCI	Sensorless vector control for induction machines	Sensorless vector control for asynchronous motors
SLVCS	Sensorless vector control for synchronous machines	Sensorless vector control for synchronous motors
SLVFCI	Sensorless voltage frequency control for induction machines	Sensorless V/f characteristic control for asynchronous motors
SPV	Supervisor (SW module)	This firmware module monitors the device status and coordinates the device protection.
	Subindex	If an object contains several parameters, they are stored in "subindexes". In this documentation the colon is used as a separator between the index and the subindex, e.g. "0x1018:0x01:". The subindex is also represented as a hexadecimal value in this documentation.
VCI	Vector control for induction machines	Vector control for asynchronous motors
VCS	Vector control for synchronous machines	Vector control for synchronous motors
VFCI	Voltage frequency control for induction machines	V/f characteristic control for asynchronous motors

1.3 Definition of the notes used

This document uses the following signal words and symbols to indicate hazards and important information:

Safety instructions

Layout of the safety instructions:

Danger!

(characterises the type and severity of danger)

Note

(describes the hazard and provides tips on how it can be avoided)

Pictograph	Signal word	Meaning
	**Danger!**	**Danger of personal injury through dangerous electrical voltage** Reference to an imminent danger that may result in death or serious injuries if the corresponding measures are not taken.
	**Danger!**	**Danger of personal injury through a general source of danger** Reference to an imminent danger that may result in death or serious injuries if the corresponding measures are not taken.
	**Stop!**	**Danger of property damage** Reference to a potential hazard that may cause damage to material assets if the corresponding measures are not taken.

Application notes

Pictograph	Signal word	Meaning
	**Note!**	Important note for trouble-free operation
	**Tip!**	Useful tip for easy handling
		Reference to another documentation

1.4 Structure of the parameter descriptions

All parameters which you can use to parameterise or monitor the MOBILE are stored within "objects".

- For the purpose of addressing, each object is provided with a unique index. In this documentation the index is represented as a hexadecimal value and is identified by a prefixed "0x", e.g. "0x1000".
- If an object contains several parameters, they are stored in "subindexes". In this documentation the colon is used as a separator between the index and the subindex, e.g. "0x1018:0x01:".

Note!

For parameters which refer to a motor or inverter, both indices (for motor/inverter A and motor/inverter B) are given in the parameter description.

- In this case, only the first index for motor/inverter A is relevant for the MOBILE DCU (one inverter).
- In this case, only the second index for motor/inverter B is relevant for the MOBILE DCU/PSU (one inverter and on-board converter).

Each parameter description is structured according to the following pattern:

Example: Structure of the parameter descriptions in this documentation

❶ ❷ ❸ 0x6046 | 0x6846 - Drive Profile Inverter A/B vl velocity max min

❹

Sub.	Name	Lenze setting	Data type
0x01	max	10000 rev/min	INT32
0x02	min	-10000 rev/min	INT32

❺

Subindex 0x01: **max**			
Upper speed limit			
Scaling factor	Setting range	Lenze setting	Data type
6.103515625000E-005	-131072 ... 131072 rev/min	10000 rev/min	INT32

❺

Subindex 0x02: **min**			
Lower speed limit			
Scaling factor	Setting range	Lenze setting	Data type
6.103515625000E-005	-131072 ... 131072 rev/min	-10000 rev/min	INT32

	Object index for device, onboard converter, or motor/inverter A
▫	Object index for motor/inverter B (with twin inverter)
▫	Parameter or object name
	If the object contains several parameters: Overview table with list of all subindexes
	Table with detailed information on the corresponding parameter

Tip!

In order to find a certain object or parameter in this documentation: The index lists all objects/parameters with a reference to the detailed description.

2 Legal disclaimer

The Bucher product does not contain safety functions or a safety system. The product may not be used for safety functions without a safety system. The safety system is the customer's responsibility. Bucher will not assume any liability if the product is used for a safety function without a safety system.

3 Introduction: Parameterising and operating the device

Being a component of a machine which includes a speed-variable drive system, the MOBILE needs to be adjusted to its drive task. The MOBILE is adjusted by changing parameters which are saved in the device. These parameters are accessed via the CAN bus.

3.1 Internal processor architecture

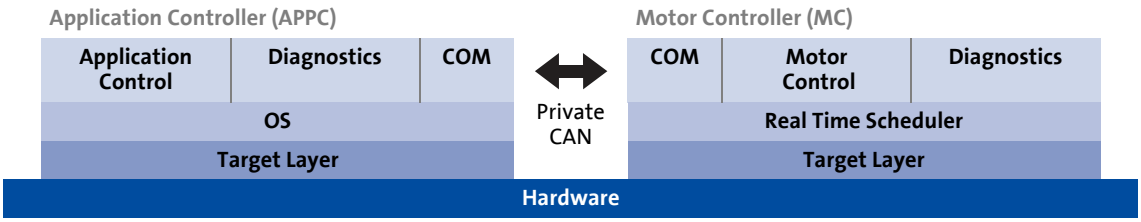
The MOBILE is operated by two microcontrollers:

- A powerful microprocessor optimised for real-time control controls the two motors or the DC/DC converter and is called "Motor Controller (MC)" in this document.
- A second controller, the "Application Controller (APPC)", takes care of the control and integration of the auxiliary equipment into the vehicle and provides powerful diagnostics according to UDS (Unified Diagnostic Services).

As these tasks are distributed to two separate processors, adaptations to customised requirements for vehicle communication and diagnostics are separated from the real-time control of the machine and thus the SW verification expenses are considerably reduced.

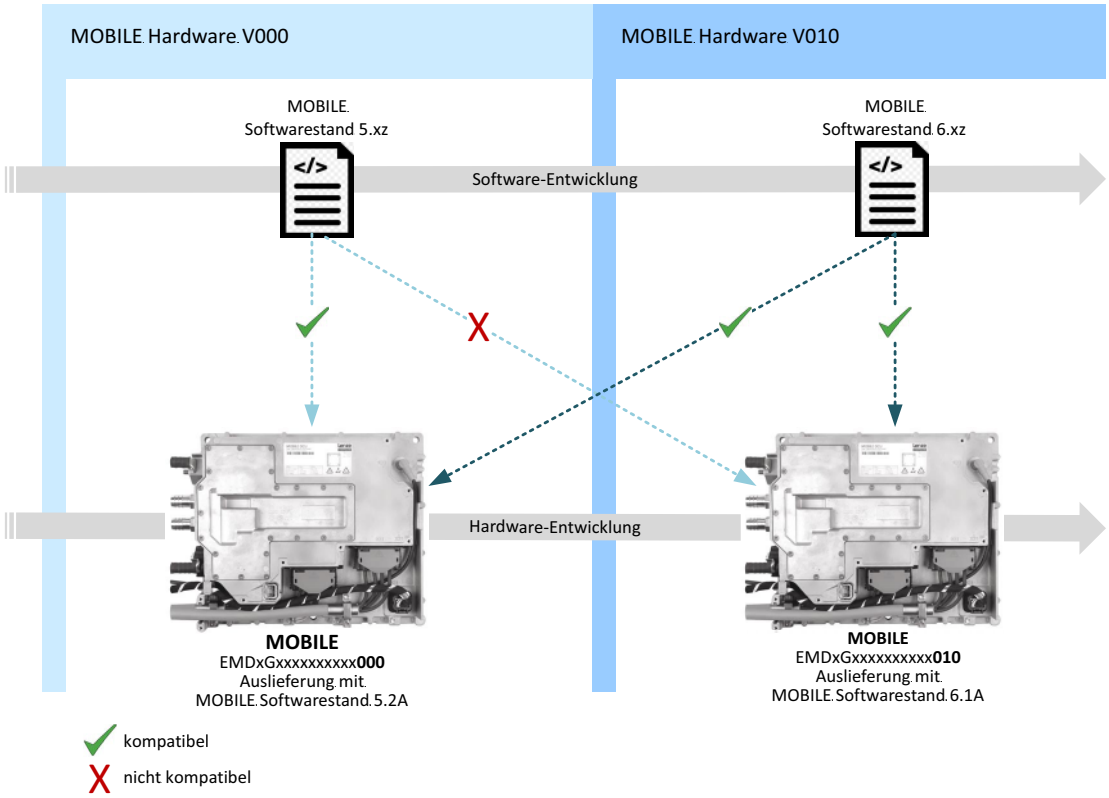
The customer can only see the Application Controller (APPC). It takes care of all communication tasks and parameter settings required for controlling all assigned drives and onboard converters. It manages the individual parameters and the parameter groups which are called data sets and enable the Motor Controller (MC) to execute the desired functions.

In the SW update process, two flash processes of the Application Controller transfer all device settings (including the firmware for both controllers) and a data set with several parameter sets to be transmitted to and saved in the MOBILE. This process ensures that only matching firmware/data record combinations compatible with the device can be commissioned. This serves to avoid any possible incompatibilities.



3.2 Hardware/firmware compatibility

The following dependencies between the hardware and firmware version statuses apply to the SW update process:



3.3 Safety applications

The Bucher product does not contain safety functions or a safety system. The product may not be used for safety functions without a safety system.

3.4 Customer interfaces

The MOBILE can be operated via the following customer interfaces:

- Public CAN: communication with vehicle or subsystem control system (e.g. air conditioning system) according to SAE J1939 / UDS
- Private CAN: Communication with subsystem or other drives according to CANopen
- Control via digital terminals (on/off)

3.4.1 Operation via Public CAN according to SAE J1939

The Public CAN is the customer interface provided for applications in commercial vehicles which can be adapted to the respective communication and diagnostic environments of the single OEMs. By default, a control according to SAE J1939 and a diagnostics according to UDS (Unified Diagnostic Services) are provided which are implemented in the Application Controller.

The messages for auxiliary equipment specified according to SAE J1939 have not been implemented (PGN 61654 – DC/AC ACCESSORY INVERTER and following PGNs).

3.4.2 Operation via Private CAN according to CANopen

The Application Controller and the Motor Controller are connected via the Private CAN (CAN 2.0A) and communicate in compliance with the Drive Profile DS 402 according to CANopen. Via this Private CAN interface, the Application Controller forwards the control commands received via the Public CAN to the Motor Controller (or to several Motor Controllers). In this process, the control commands are mapped to the available devices and required conversions are carried out. On the other hand, the Application Controller forwards the status information (actual values or error information) received by the Motor Controller (or by several Motor Controllers) to the master control via the Public CAN.

For special application cases, this separation enables Motor Controllers and thus connected motors and equipment to be directly triggered via the Private CAN. In this case, the CANopen protocol is used.

The Private CAN serves as configuration interface and diagnostic interface at the same time which is able to check and diagnose complex drive functions. It serves as fall-back solution for commissioning if the Public CAN (vehicle CAN) does not provide the required bandwidth or the service tools are not able to process the real-time information. This interface is robust enough to ensure a reliable diagnostics in the field and in the laboratory.

3.4.3 Operation via terminals

Each of the four inputs FLX_IN1 ... FLX_IN4 has a parameter which serves to configure the function of the input. Each of the four outputs FLX_OUT1 ... FLX_OUT4 has a parameter as well which serves to configure the function of the output.

▸ FLX_IN1 ... FLX_IN4 (📖 49)
▸ FLX_OUT1 ... FLX_OUT4 (📖 56)

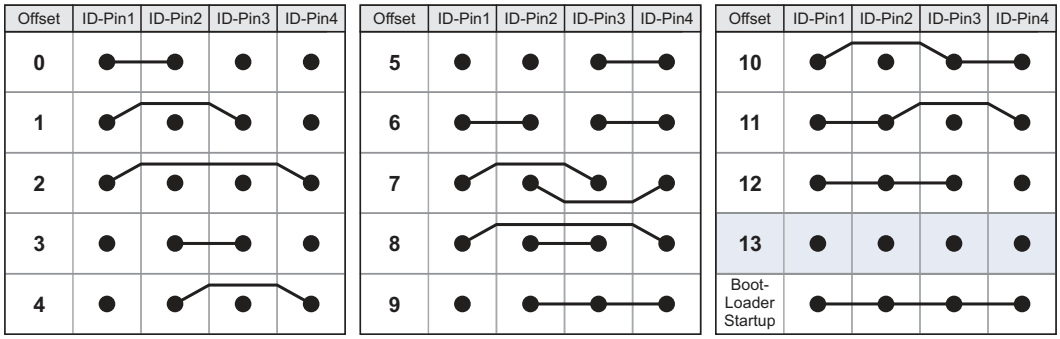
3.5 Device identification

3.5.1 MOBILE DCU, PSU, DCU PSU

CAN address allocation

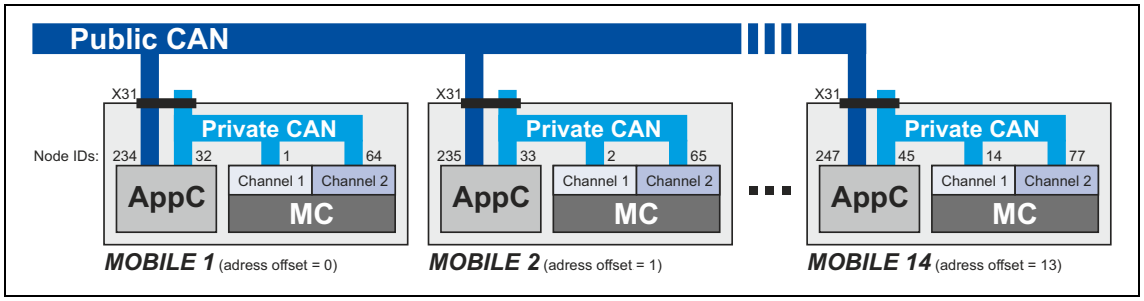
A maximum of 14 MOBILEs can be operated on a CAN bus. Each MOBILE has a CAN address for the public CAN and three CAN addresses for the Private CAN. The CAN addresses result from an individual basic address (parameterisable) plus an address offset (0 ... 13).

The address offset is defined through bridges between four terminals at X31, also called ID pins. If the four ID pins are not interconnected, the address offset = 13:



[3-1] Setting of the address offset via the ID pins at X31

The following representation shows the principle of the CAN address allocation when the preset basic addresses are used:



[3-2] Address allocation for Public CAN and Private CAN

The basic addresses can be changed via the following objects of the Application Controller:

Object	Name	Info	Default setting
0x4020:0x02	baseAddr	Public CAN basic address	234
0x4030:0x02	baseAddrAppc	Private CAN basic address of the APPC	32
0x4030:0x03	baseAddrMc	Private CAN basic address of the MC (channel 1) • As of version CECA0AA007A of the MC boot loader and as of firmware 06.0, communication is possible via channel 1 and channel 2.	1
		Private CAN basic address of the MC (channel 2) • The CAN basic address of channel 2 has a constant offset from 63 to the set *baseAddrMc*. **Note:** Use the channel 2 for external diagnostic tools (e.g. »MOBILE Engineer«).	64

Boot Loader Startup

In the "Boot loader startup" mode the following settings are active:

- Public CAN address = 246 (permanent)
- Baud rate = 250 kbps (permanent)
- No access to the Private CAN

MOBILE device number

In order to address a certain device in a network of several MOBILEs, each MOBILE has a device number (1 ... 14) which corresponds to the set address offset (ID pins) plus 1.

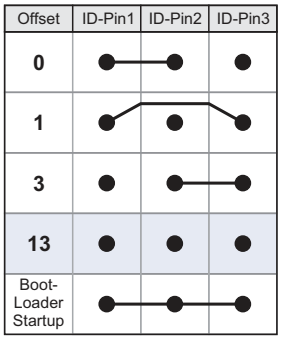
- The device number is part of the "broadcast" PGN. Parameter Group Number (PGN) (📖 171)
- The device number is displayed in the Public CAN transmit message "Device status of the MOBILE". (📖 179)

3.5.2 MOBILE DCU S

CAN address allocation

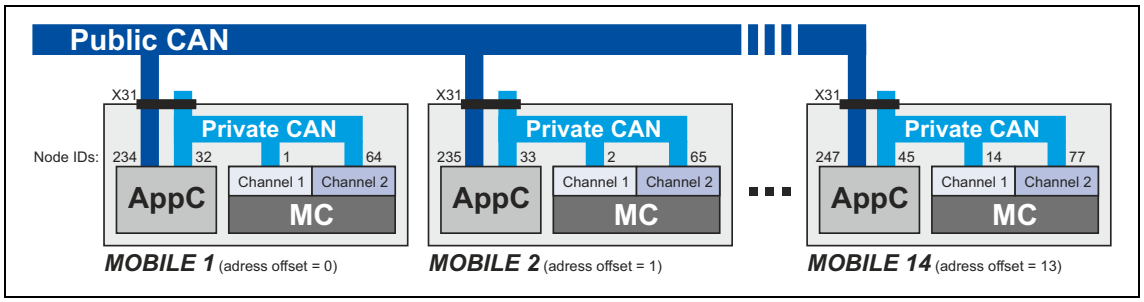
A maximum of 4 MOBILEs can be operated on a CAN bus. Each MOBILE has a CAN address for the public CAN and three CAN addresses for the Private CAN. The CAN addresses result from an individual basic address (parameterisable) plus an address offset (0, 1, 3, 13).

The address offset is defined through bridges between three terminals at X1, also called ID pins. If the three ID pins are not interconnected, the address offset = 13:



[3-3] Setting of the address offset via the ID pins at X1

The following representation shows the principle of the CAN address allocation when the preset basic addresses are used:



[3-4] Address allocation for Public CAN and Private CAN

The basic addresses can be changed via the following objects of the Application Controller:

Object	Name	Info	Default setting
0x4020:0x02	baseAddr	Public CAN basic address	234
0x4030:0x02	baseAddrAppc	Private CAN basic address of the APPC	32
0x4030:0x03	baseAddrMc	Private CAN basic address of the MC (channel 1) • As of version CEDA0AA007A of the MC boot loader and as of firmware 06.0, communication is possible via channel 1 and channel 2.	1
		Private CAN basic address of the MC (channel 2) • The CAN basic address of channel 2 has a constant offset from 63 to the set *baseAddrMc*. **Note:** Use the channel 2 for external diagnostic tools (e.g. »MOBILE Engineer«).	64

Boot Loader Startup

In the "Boot loader startup" mode the following settings are active:

- Public CAN address = 246 (permanent)
- Baud rate = 250 kbps (permanent)
- No access to the Private CAN

MOBILE device number

In order to address a certain device in a network of several MOBILEs, each MOBILE has a device number (1 ... 4) which corresponds to the set address offset (ID pins) plus 1.

- The device number is part of the "broadcast" PGN. Parameter Group Number (PGN) (📖 171)
- The device number is displayed in the Public CAN transmit message "Device status of the MOBILE". (📖 179)

3.6 Change parameter settings

The engineering tools “MOBILE Engineer” and “MOBILE Starter” are available for the online diagnosis, parameter setting and commissioning of the MOBILE. They communicate with the MOBILE via the Private CAN or Public CAN interfaces. The “MOBILE Engineer” can access the object directory of the application and motor controller.

MOBILE Panels extend the functionality of the “MOBILE Engineer”. Various activities can be simplified and automated with MOBILE panels.

For the communication between the PC (with the "MOBILE Engineer" or "MOBILE Starter" software installed) and MOBILE, the PC system bus adapter IPEH-002022 (Peak System) can be used (USB interface):

- Connect PC system bus adapter to the respective CAN interface of the MOBILE.
- Connect PC system bus adapter to the PC via a free USB port.

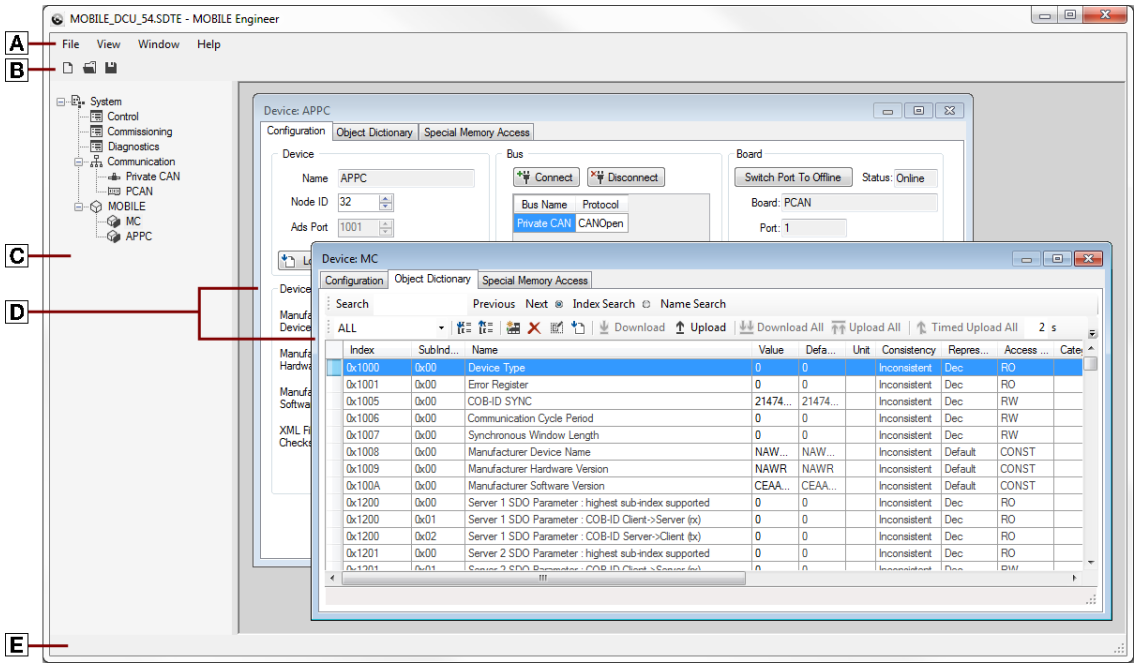
Compared to the “MOBILE Engineer”, the “MOBILE Starter” has a smaller functional range. The two engineering tools differ in terms of MOBILE Panels and the trace function.

Functional range of “MOBILE Engineer” and “MOBILE Starter”

Range	»MOBILE Engineer«	»MOBILE Starter«
MOBILE Panel		
MOBILE Diagnostics: Device Identification Public CAN	●	●
MOBILE Diagnostics: Event Memory Public CAN	●	●
MOBILE Diagnostics: Application Data Upload Public Private CAN	●	–
MOBILE Commissioning: CanIdScan Public and Private CAN	●	●
MOBILE Commissioning: Firmware Download Public CAN	●	●
MOBILE Commissioning: Dataset Upload Public CAN	●	●
MOBILE Commissioning: Parameter Manager	●	–
MOBILE Commissioning: DC Control Private CAN	●	–
MOBILE Commissioning: SLVFCI Private CAN	●	–
MOBILE Commissioning: VCI/SLVCI Private CAN	●	–
MOBILE Commissioning: VCS/SLVCS Private CAN	●	–
MOBILE Commissioning: Feedback Private CAN	●	–
MOBILE Commissioning: Resolver Settings Private CAN	●	–
MOBILE Commissioning: Speed Controller Private CAN	●	–
MOBILE Commissioning: Motor Control Inverter A/B Private CAN	●	–
MOBILE Commissioning: Summary of different UDS Services Public CAN	●	–
Trace function		
Online	●	–
Offline	●	–

3.6.1 User interface

The »MOBILE Engineer« contains the following control and function elements:

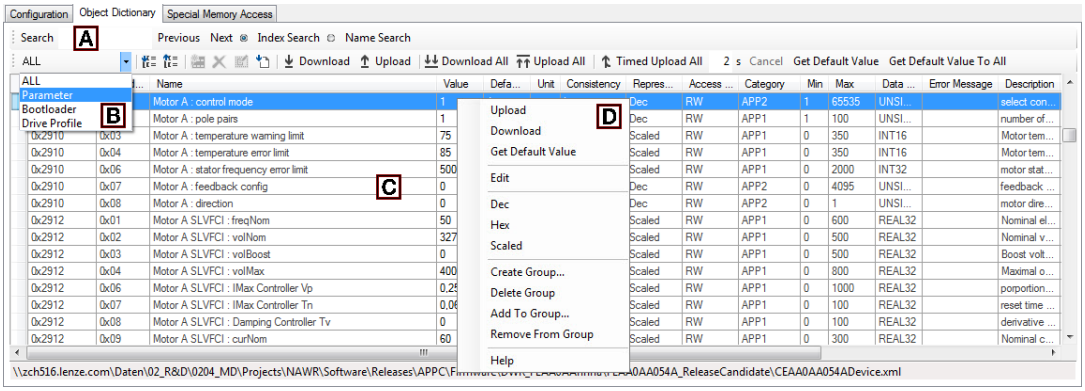


A Menu bar	C System browser	E Status bar
B Toolbar	D Configuration window	

If you click an element in the *system browser*, the corresponding configuration window will be open. Several configuration window can be open at the same time. The open windows can be managed (e.g. arranging them next to each other or below each other in the workspace) via the commands in the **Window** menu.

3.6.2 Object directory

When an online connection has been established to the MOBILE, the **Object Dictionary** tab displays the current parameter settings of the Application or Motor Controller and can be changed here too:



A Search bar for finding a certain index or object name

B **Group selection** list field for filtering the object list

C Object list (contains all objects of the group selected in the **Group selection** list field)

D Context menu (call via right mouse button)

Object dictionary toolbar

Icon/command		Function
		Import groups
		Export groups
		Create new object in the object directory
		Delete selected object
		Edit selected object
		Load device XML
	Download	Download selected object to the device
	Download All	Download all objects to the device
	Upload	Upload selected object from the device
	Upload All	Upload all objects from the device
	Timed Upload All	Upload all objects cyclically from the device • The time interval can be set in [s] in the input field after the command. • **Cancel** serves to exit the cyclic upload again.
	Get Default Value	Reset selected object to default setting • The value in the device only changes when the object has been written to the device (download).
	Get Default Value To All	Reset all objects to default setting • The values in the device only change when the objects have been written to the device (download).

Parameter categories

Parameters are divided into the following categories:

Category	Info
APP	Parameters relevant for the application and motor control. These parameters can be changed and can be stored in the non-volatile memory.
APP1	Parameters that are not protected during operation and that can be changed in any status and applied immediately (e.g. controller parameters, limits).
APP2	Parameters protected during operation that may only be changed if the corresponding inverter is switched off. The changed parameters are applied after restarting (e.g. Modes of Operation, Application).
APP3	Parameters protected during operation that may only be changed if both inverters are switched off. The changed parameters are applied after restarting (e.g. Option Config).
APP4	Parameters that force a restart and that are only applied after a reset via terminal 15 (e.g. baud rate, node ID, Position Device Type, Supply Config). Parameter sets that change parameters of this category may not be activated by a parameter set changeover!
CMD	These parameters are variables (setpoints) which are available as CAN objects and trigger certain actions when being written (via SDO or PDO transfer) with certain values.
DIA	Firmware-related parameters and variables which are exclusively used for firmware tests. These parameters can be changed to some extent but cannot be changed.
MAP	Parameters for PDO mapping.

Changes to APPC parameters become effective:

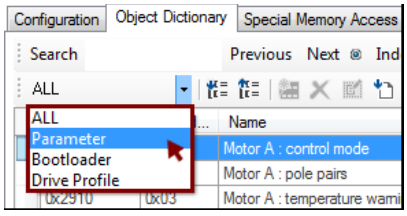
- After saving the parameters and a subsequent restart.
- Immediately with a parameter set changeover. The criteria according to the parameter category then apply.

Note!

Parameter sets that contain parameters of the category MAP and thus change the PDO mapping may not be activated by a parameter set changeover!

Use display filters for the object directory

If the "ALL" entry has been selected in the **Group selection** list field, the *object list* displays all CANopen objects of the prevailing Controller:

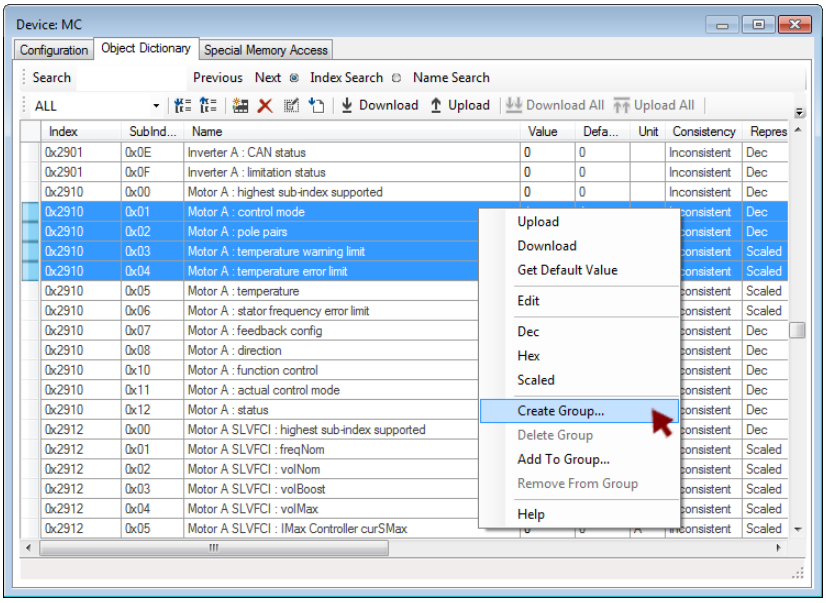


Selecting a different group serves to "filter" the display. If you select, for instance, the "parameter" group, only the objects to be parameterised will be displayed.

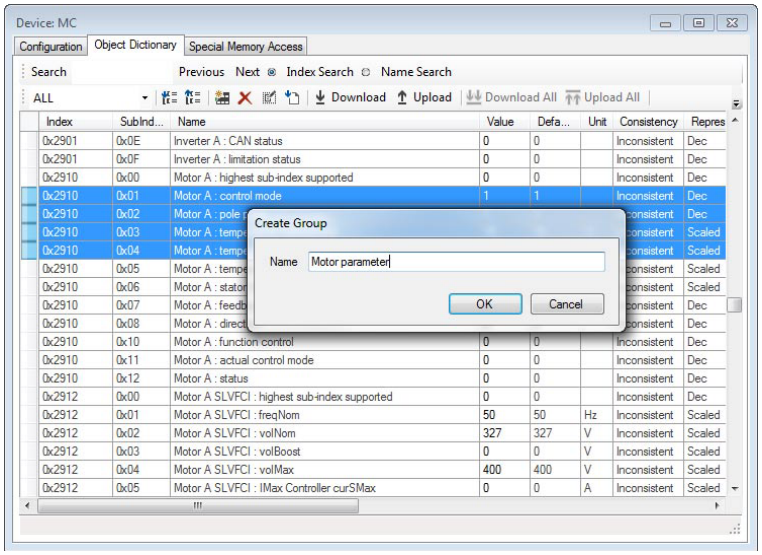
For a quick access on frequently required objects, you can also create new groups.

How to create a new group:

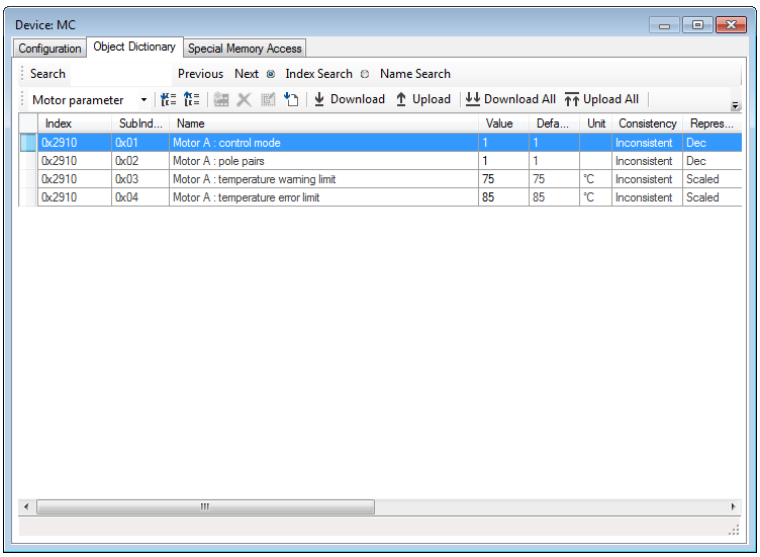
1. Select the objects to be part of the new group in the *Object list*.
   - Keep the **<Ctrl>** key pressed to allow for a multi-selection.
   - Keep the **<Ctrl>** key pressed to allow for an area selection.
   - Further objects can be added subsequently to the group .
2. Execute the command **Create Group...** via the *context menu* (right mouse button):



3. Enter a name for the new group in the *Create Group* dialog field and confirm the entry with **OK**:



The new group is added to the **Group selection** list field.
The *object list* now only displays the objects assigned to the group:



Group-relevant functions in the context menu

Context menu command	Function
Create Group...	Create a new group with the selected objects
Delete Group	Delete the currently displayed group
Add To Group...	Add the selected objects to a group already available
Remove From Group	Remove selected objects from the group

3.7 Save parameter settings permanently in the MOBILE

Parameter changes in MOBILE via the “MOBILE Engineer”/”MOBILE Starter” or by a higher-level control via CAN communication will be lost if the supply voltage is switched off unless the settings have been saved in the MOBILE.

Save parameter settings via Private CAN

The Application Controller (APP) provides the CAN objects to save the parameter settings in various parameter sets. A write access with the value “1234” triggers the process.

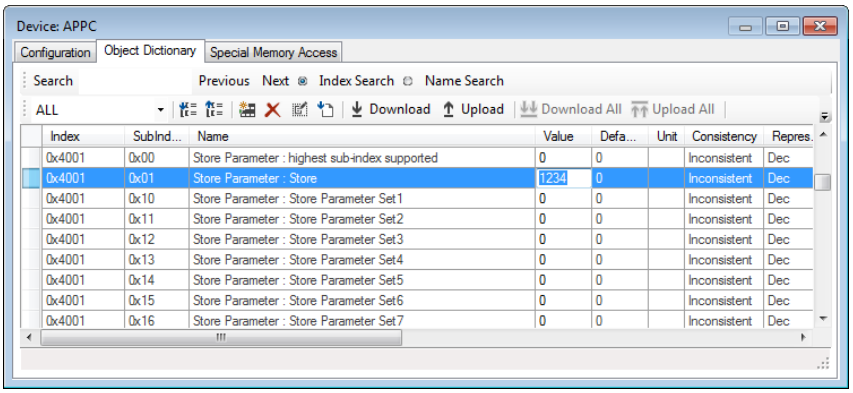
Note!

- The values are saved permanently in the flash memory with the store command.
- By uploading to the same object, you can check whether the save command was successful (1234 = Store successfully completed).

Index	Name	Description
0x4001:0x01	Store	Save current parameters in the parameter set selected by the ID pins. ▸ MOBILE DCU, PSU, DCU PSU (📖 18) ▸ MOBILE DCU S (📖 20)
0x4001:0x10	Store Parameter Set1	Save current parameters in parameter set 1
0x4001:0x11	Store Parameter Set2	Save current parameters in parameter set 2
0x4001:0x12	Store Parameter Set3	Save current parameters in parameter set 3
0x4001:0x13	Store Parameter Set4	Save current parameters in parameter set 4
0x4001:0x14	Store Parameter Set5	Save current parameters in parameter set 5
0x4001:0x15	Store Parameter Set6	Save current parameters in parameter set 6
0x4001:0x16	Store Parameter Set7	Save current parameters in parameter set 7
0x4001:0x17	Store Parameter Set8	Save current parameters in parameter set 8
0x4001:0x18	Store Parameter Set9	Save current parameters in parameter set 9
0x4001:0x19	Store Parameter Set10	Save current parameters in parameter set 10
0x4001:0x1A	Store Parameter Set11	Save current parameters in parameter set 11
0x4001:0x1B	Store Parameter Set12	Save current parameters in parameter set 12
0x4001:0x1C	Store Parameter Set13	Save current parameters in parameter set 13
0x4001:0x1D	Store Parameter Set14	Save current parameters in parameter set 14

Save parameter settings via “MOBILE Engineer”/”MOBILE Starter” in a manner safe from power failure

- Select the object 0x4001 (store parameter) in the application controller (APPC).
- Set the value “1234” in the desired subindex (0x01 ... 0x1D) and confirm the entry with **<ENTER>**.



3.8 Load parameter set

Loading a parameter set overwrites the active parameters in the MOBILE. A precondition for successful loading is a valid parameter set. The MOBILE switches to error status if loading is defective. Device status (📖 37)

Load parameter set via Private CAN

The Application Controller (APP) provides the CAN objects to load the various parameter sets. A write access with the value “1234” triggers the process.

Note!

- By uploading to the same object, you can check whether the save command was successful (1234 = Store successfully completed).

Index	Name	Description
0x4002:0x01	Restore	Load the parameter set selected by the ID pins. ▸ MOBILE DCU, PSU, DCU PSU (📖 18) ▸ MOBILE DCU S (📖 20)
0x4002:0x10	Restore Parameter Set1	Load parameter set 1
0x4002:0x11	Restore Parameter Set2	Load parameter set 2
0x4002:0x12	Restore Parameter Set3	Load parameter set 3
0x4002:0x13	Restore Parameter Set4	Load parameter set 4
0x4002:0x14	Restore Parameter Set5	Load parameter set 5
0x4002:0x15	Restore Parameter Set6	Load parameter set 6
0x4002:0x16	Restore Parameter Set7	Load parameter set 7
0x4002:0x17	Restore Parameter Set8	Load parameter set 8
0x4002:0x18	Restore Parameter Set9	Load parameter set 9
0x4002:0x19	Restore Parameter Set10	Load parameter set 10
0x4002:0x1A	Restore Parameter Set11	Load parameter set 11
0x4002:0x1B	Restore Parameter Set12	Load parameter set 12
0x4002:0x1C	Restore Parameter Set13	Load parameter set 13
0x4002:0x1D	Restore Parameter Set14	Load parameter set 14

Load parameter set via inputs FLX_IN1 ... FLX_IN4

To load a parameter set via FLX_IN1 ... FLX_IN4, the input must be assigned the corresponding function.

- MOBILE DCU, PSU, DCU PSU (📖 18)
- MOBILE DCU S (📖 20)

The parameter set is loaded by changing the level at the input. Further changes to the level have no effects. A new parameter set can only be loaded when the preceding parameter set has been loaded.

A parameter set can also be loaded via UDS:

- $31: Routine Control, $FE01: Store Parameter Set

3.9 MOBILE Panels

MOBILE Panels extend the functionality of the “MOBILE Engineer” and “MOBILE Starter”. Various activities can be simplified and automated with MOBILE panels, for example:

- Firmware download
- Dataset download
- Parameter setting of the asynchronous motor or synchronous motor
- Parameter setting of the inverter, resolver, DC/DC converter
- Configuration of sensors
- Reading out the event memory
- Controlling the motor or DC/DC converter
- Diagnosis of the connected devices

Various MOBILE Panels are available for the different tasks and applications. Following installation, the MOBILE Panels are available as apps in the engineering tool.

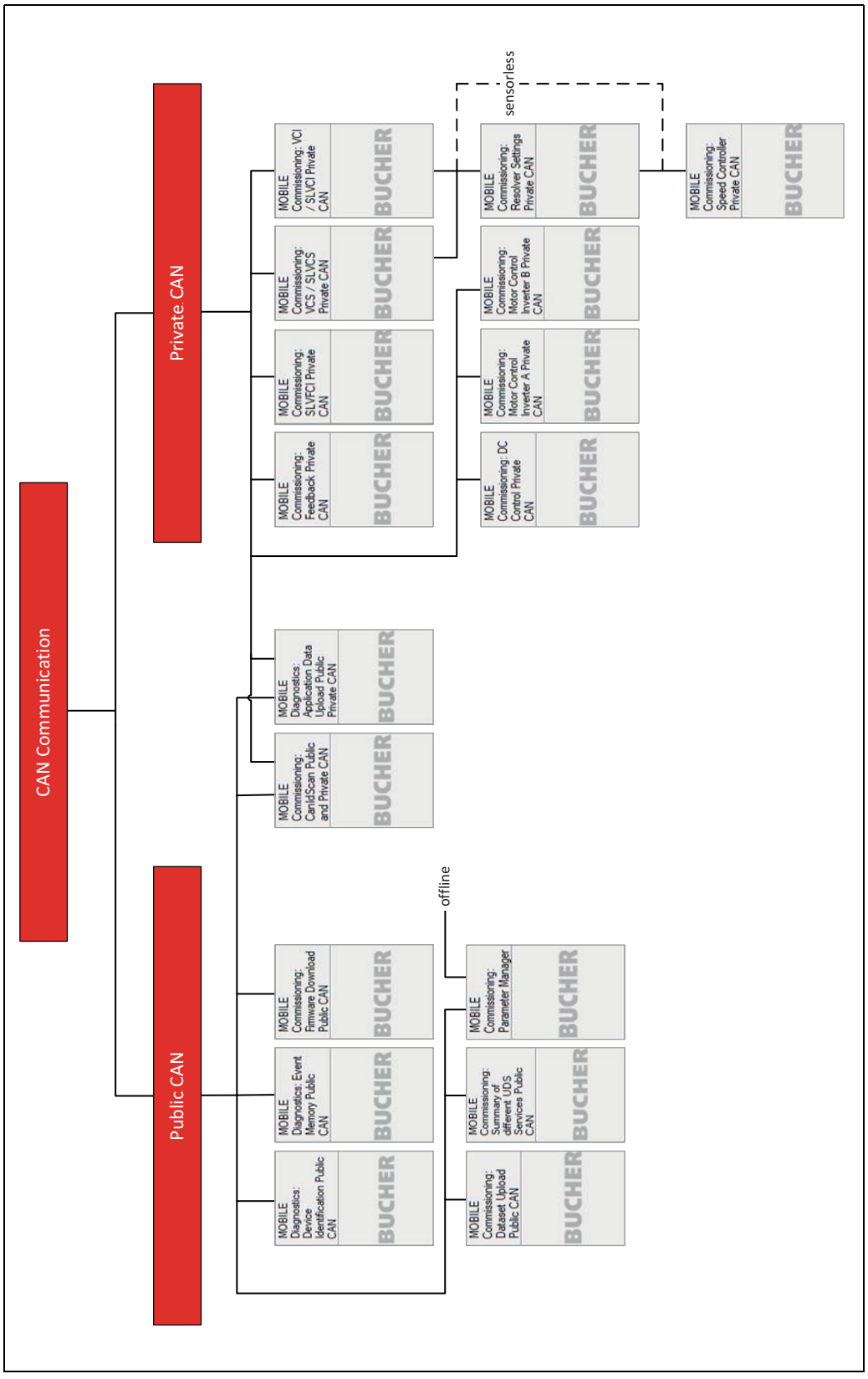
A limited number of MOBILE panels are available after installation of the “MOBILE starter”:

- MOBILE Commissioning: CanIdScan Public and Private CAN
- MOBILE Commissioning: Firmware Download Public CAN
- MOBILE Commissioning: Dataset Upload Public CAN
- MOBILE Diagnostics: Device Identification Public CAN
- MOBILE Diagnostics: Event Memory Public CAN

Tip!

The installation packages and documentation for the MOBILE Panels can be found on the Internet www.bucherdrives.com ➞ Downloads ➞ Software Downloads.

- First register via “Request User Access for Panels”. You will then be sent a link for the login.

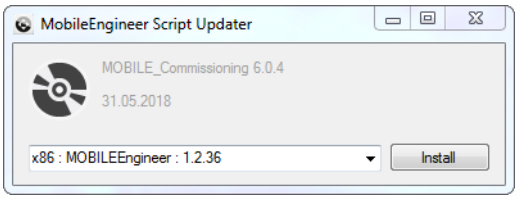


[3-5] Structure of the MOBILE Panels in the "MOBILE Engineer"

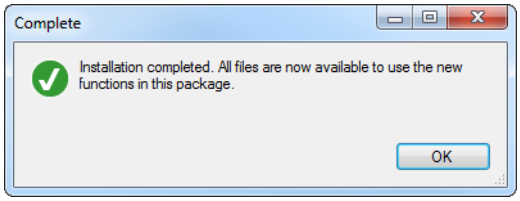
3.9.1 Install the commissioning panels

How to install the MOBILE Panels:

1. Download the installation package “PanelItemMOBILE_Commissioning_x.x.x.exe”.
2. Close “MOBILE Engineer” or “MOBILE Starter”.
3. Run the “PanelItemMOBILE_Commissioning_x.x.x.exe” file.
4. Check that the versions of the ”MOBILE Engineer” or “MOBILE Starter” and the MOBILE Panels are correct:



5. Install MOBILE Panels. The following dialog box appears after successful installation:

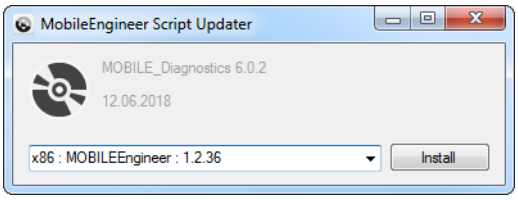


The MOBILE Panels are now available in the “MOBILE Engineer” or “MOBILE Starter”. The application documentation in the **Help** menu has been updated and now contains the description of the MOBILE Panels as well.

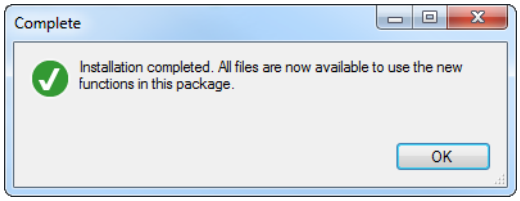
3.9.2 Install the diagnostics panels

How to install the MOBILE Panels:

1. Download the installation package “PanelItemMOBILE_Diagnostics_x.x.x.exe”.
2. Close “MOBILE Engineer” or “MOBILE Starter”.
3. Run the “PanelItemMOBILE_Diagnostics_x.x.x.exe” file.
4. Check that the versions of the ”MOBILE Engineer” or “MOBILE Starter” and the MOBILE Panels are correct:



5. Install MOBILE Panels. The following dialog box appears after successful installation:



The MOBILE Panels are now available in the “MOBILE Engineer” or “MOBILE Starter”. The application documentation in the **Help** menu has been updated and now contains the description of the MOBILE Panels as well.

4 Commissioning

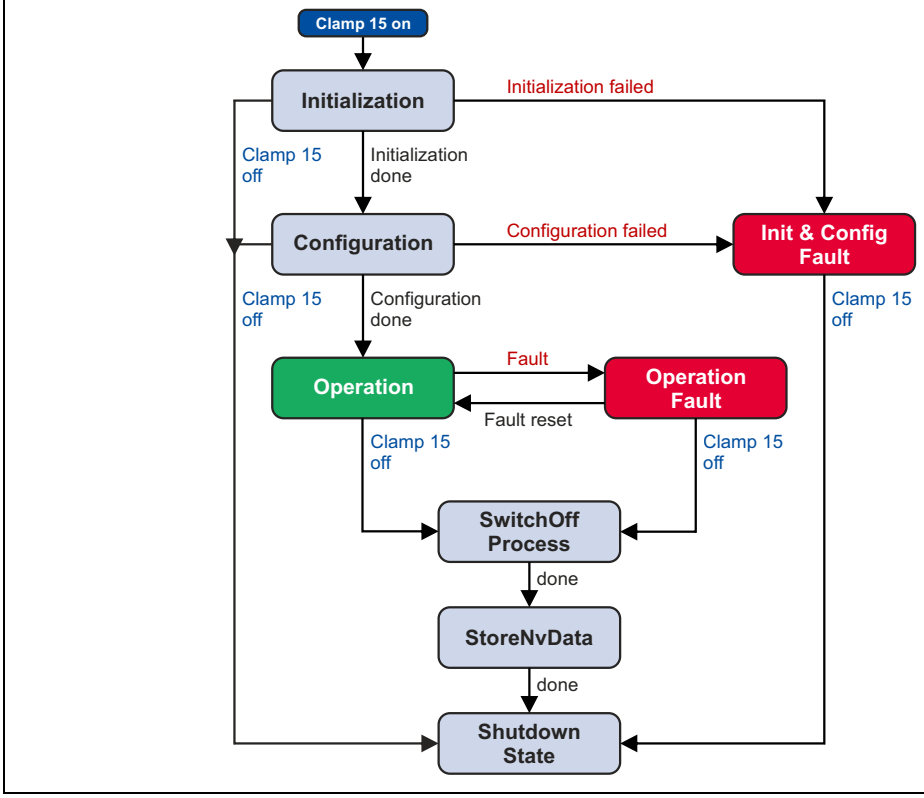
In case of initial commissioning, the access can be carried out, for instance, via the PC using the »MOBILE Engineer« engineering tool via the Private CAN. During operation, the vehicle control system communicates with the MOBILE via the Public CAN. ▸ Customer interfaces (📖 17)

4.1 Switch on the device

Stop!

Before initial switch-on: Before switching on the MOBILE for the first time, check the entire wiring for completeness, short circuit and earth fault!

System states and start-up (simplified representation)



Condition	Info
Initialisation	Initialisation of the system (identification, file system)
Configuration	Configuration of the system (firmware check, communication, parameter setting)
OPERATION	Operating status • In this state, the MOBILE is able to be operated as intended.
SwitchOff Process	Disconnection of the inverter and gate drivers
StoreNvData	Saving the process data (error memory, etc.)
Shutdown	Shutdown of the system
Operation fault	Error status during operation • Reset depending on the error type (fault reset or shutdown via terminal 15).
Init & Config Fault	Error status during initialisation or configuration of the system • Reset only possible via shutdown via terminal 15.

Event	Info
Fault reset	"Terminal 15 internal" to low for 0.1 ... 1.4 s (0x4010:0x03)
Clamp 15 off	"Terminal 15 internal" to low for ÷1.5 s (0x4010:0x03)

4.1.1 Device status

MOBILE DCU, PSU, DCU PSU

Two LEDs at the device display the current device status:

LED1	LED2	Device status	Comments	
○		Switched off	–	
●		Switched on - nor error	No Public CAN messages are received.	
◉		Switched on - nor error	Public CAN messages are received.	
◉		Switched on - boot loader active	–	
●		Switched on - error	For a more detailed diagnosis, read out the error memory or error code (0x4003:1). ▸ Diagnostics & error management (📖 212)	
◉		Switched on - error	CAN communication is interrupted. Diagnostics via CAN is not possible.	
			1 blinking:	Invalid CAN address offset
			4 blinking:	Initialisation of the internal flash failed
			5 blinking:	Bootloader/firmware incompatibility
	●	DC bus loaded	V_{DC} > 50 V	
	◉	Precharge active	Blinking slowly	
	◉	Cover not closed	Blinking fast (Precondition: monitoring for opened MOBILE cover is activated in 0x2730:0x05)	

○ LED off

◉ LED blinking every 0.4 s

◉ LED blinking every 0.2 s

◉ LED blinking pattern: blinking once or several times with a break of 1 s

- The device status can also be read via the CAN bus.
- The Bucher "MOBILE Engineer" allows for detailed diagnostics.

Note!

Error message via hardware signal

The default setting also provides an error message regarding the FLX_OUT outputs:

- Error INV A/DCDC → FLX_OUT1 output set to HIGH level.
- Error INV B → FLX_OUT2 output is set to HIGH level.

▸ FLX_OUT1 ... FLX_OUT4 (📖 56)

MOBILE DCU S

- The device status can only be read via the CAN bus.
- The Bucher "MOBILE Engineer" allows for detailed diagnostics.

4.1.2 Terminal 15 signal

Note!

- The hardware signal of terminal 15 is linked to the system status of terminal 15 ("Clamp15_CAN") received by the master control via the Public CAN Receive message 0 according to the following table.
- The hardware signal of the terminal 15 has to be pending once for approx. 1 s in order that the control (Application Controller) "wakes up".
- As soon as the resulting signal (internal terminal 15) is missing for 1500 ms (default setting) or longer, the firmware initiates a shutdown.
  - Shutdown delay time for MOBILE DCU, PSU, DCU PSU: 0x4010:0x03
  - Shutdown delay time for MOBILE DCU S: 0x4010:0x03

Clamp15_CAN (firmware signal)	Terminal 15 (hardware signal)	Terminal 15 internal
0	0	0
	1	**1**
1	0	**1**
	1	**1**
Signal not available	0	0
	1	**1**

Error reset via "Terminal 15 internal"

By means of a quick reset of the "Terminal 15 internal" signal, an inverter which was switched off due to an error can be reset from the error state to the operating state. Inverters without any errors will continue to be operated without any interruption.

In order to force an error reset, the "Terminal 15 internal" signal has to be set to LOW level for a certain period of time (depending on the shutdown delay time in 0x4010:0x03, default setting 0.1 ... 1.4 s). If the signal is absent for longer, the firmware initiates a shutdown.

▸ Switch on the device (📖 36)

An error can also be reset via the "FaultReset" service.

▸ "Services" overview (📖 184)

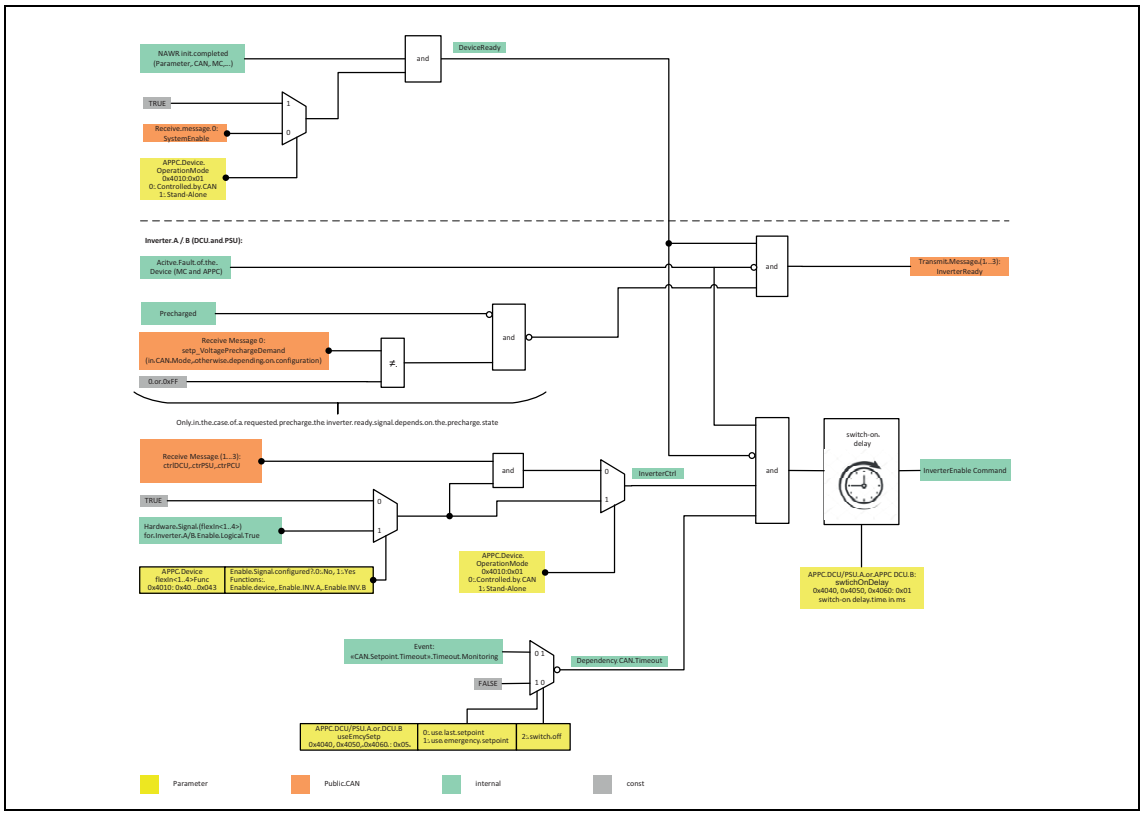
Related topics:

▸ Status of the master control (📖 174)

4.1.3 Inverter Ready status and switch-on conditions

To switch on the relevant output (DCU and PSU), the following conditions shown in the signal flow must be met:

- System enable: DeviceReady
- Inverter enable: InverterCtrl
- Switch-on delay elapsed
- No active errors



[4-1] Inverter Ready status and switch-on conditions

Tip!

The Public CAN signals shown in the diagram are described in detail in the following chapters:

- Public CAN receive messages (📖 173)
- Public CAN transmit messages (📖 178)

4.1.4 System enable

The following conditions have to be met for the readiness for operation of the MOBILE:

1. Terminal 15 signal available.
2. The device has to be booted up completely. This includes the initialisation and parameter setting of the Application Controller (APPC) and the Motor Controller (MC) as well as the CAN communication.
3. If controlled via Public CAN (default setting; configurable in 0x4010:0x01):
   The master control must have received the enable signal.
   - Public CAN Receive message 0 → SystemEnable = 1

4.1.5 Controller enable

In order that the inverter can be switched on, controller enable needs to be activated. This enable is monitored separately for each inverter.

The following conditions have to be met for controller enable:

1. Terminal 15 signal available.
2. System enable available.
3. If controlled via Public CAN (default setting; configurable in 0x4010:0x01):
   The master control must have received the switch-on signal.
   - Inverter A: Public CAN Receive message 1 → ctrlDCU = 1
   - Inverter B: Public CAN Receive message 2 → ctrlDCU = 1
   - Onboard converters: Public CAN Receive message 3 → ctrlPSU = 1
4. Enable signal via FLX_INx available (if configured).
   ▸ FLX_IN1 ... FLX_IN4 (📖 49)
5. Switch-on delay for 1st and 2nd elapsed (if configured).

Switch-on delay

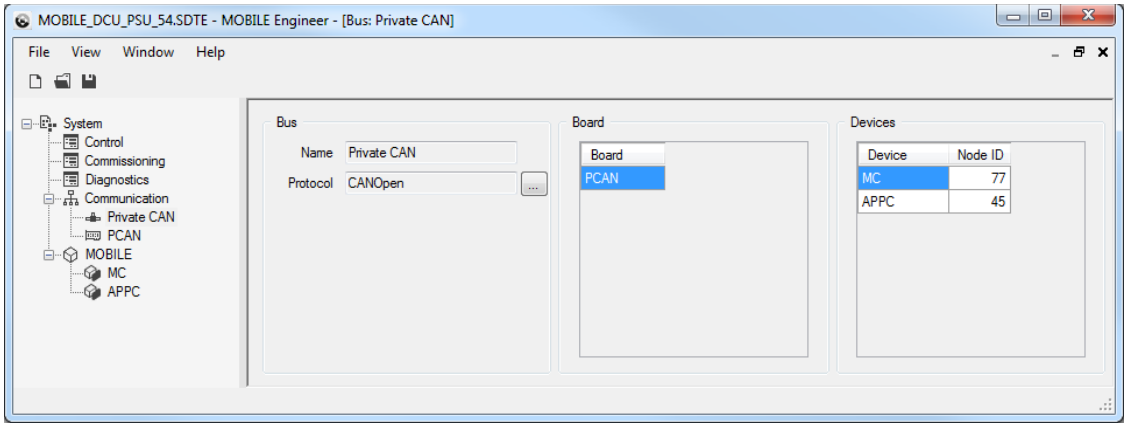
By setting a switch-on delay, the consumers can be switched on in a scaled manner. The switch-on delay is started as soon as all enable conditions are available. If one conditions fails, the timer is reset. No switch-on delay is set in the default setting.

Switch-on delay for	Configuration	Possible settings
Inverter A	0x4040:0x01	0 ... 65535 [ms]
Inverter B	0x4050:0x01	
Onboard converters	0x4060:0x01	

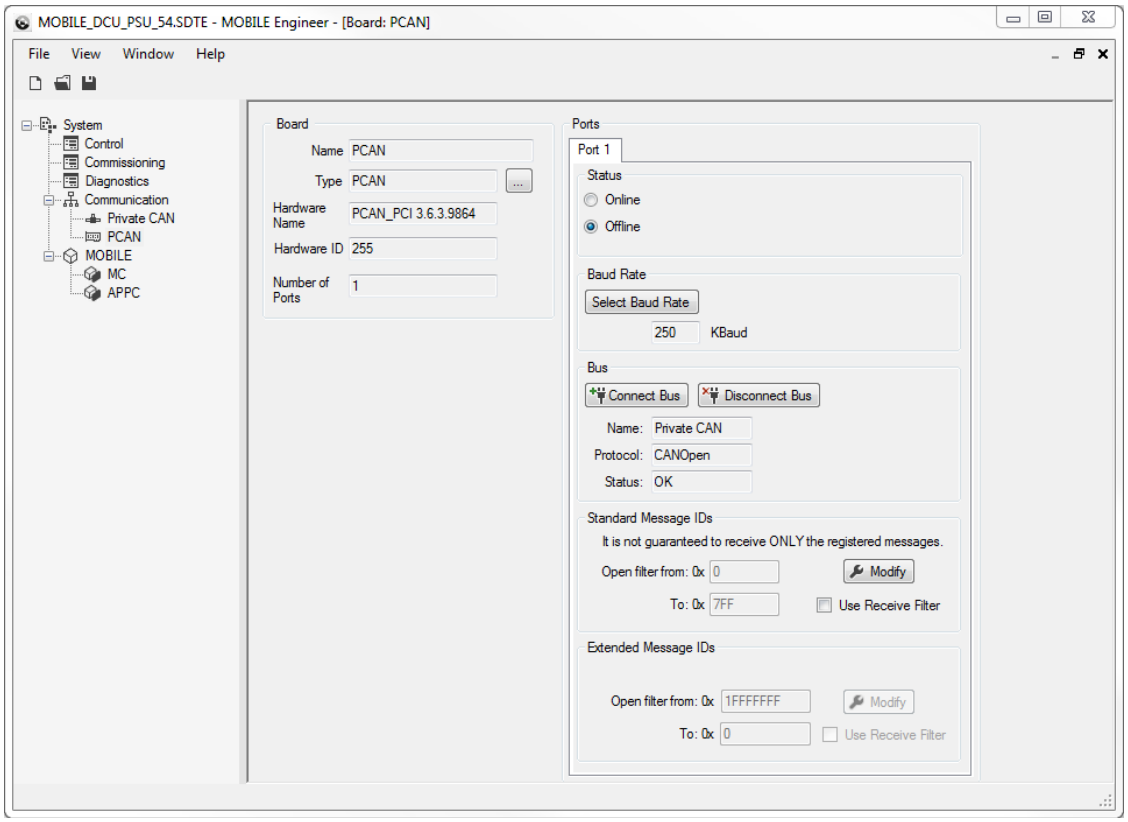
4.2 Establish a communication with »MOBILE Engineer« via Private CAN

Settings of protocol and CAN addresses:

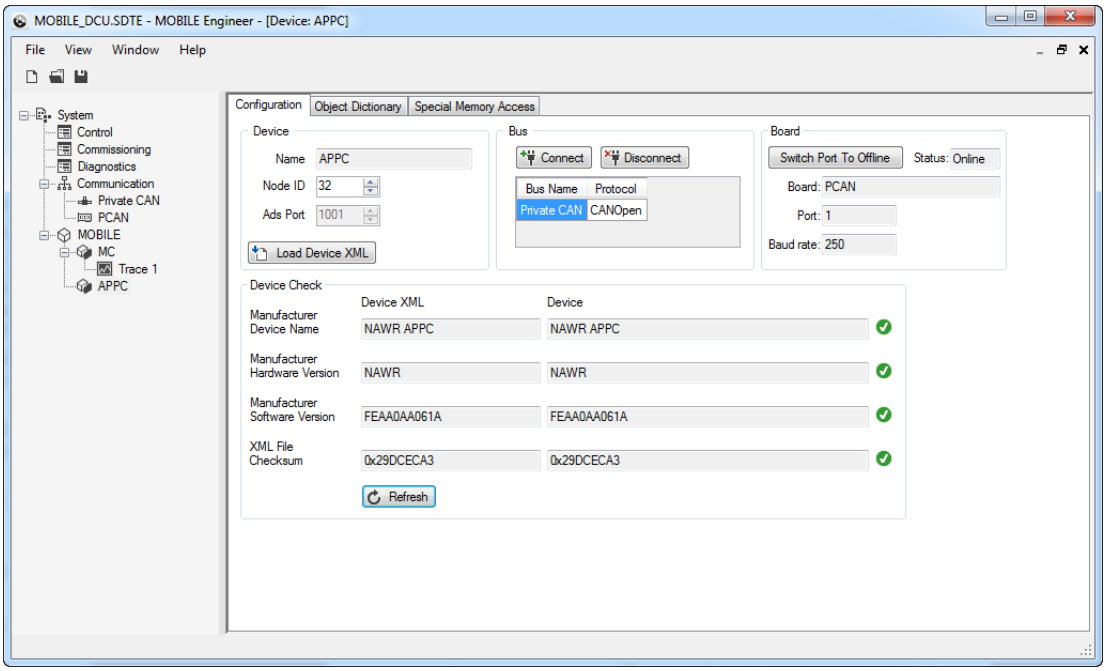
For a communication via Private CAN, set the CAN addresses in the »MOBILE Engineer« of the MOBILE to be parameterised. General information on CAN address allocation can be found in the chapter entitled "Device identification". (📖 18)



Settings for PC system bus adapter IPEH-002022 (Peak System):

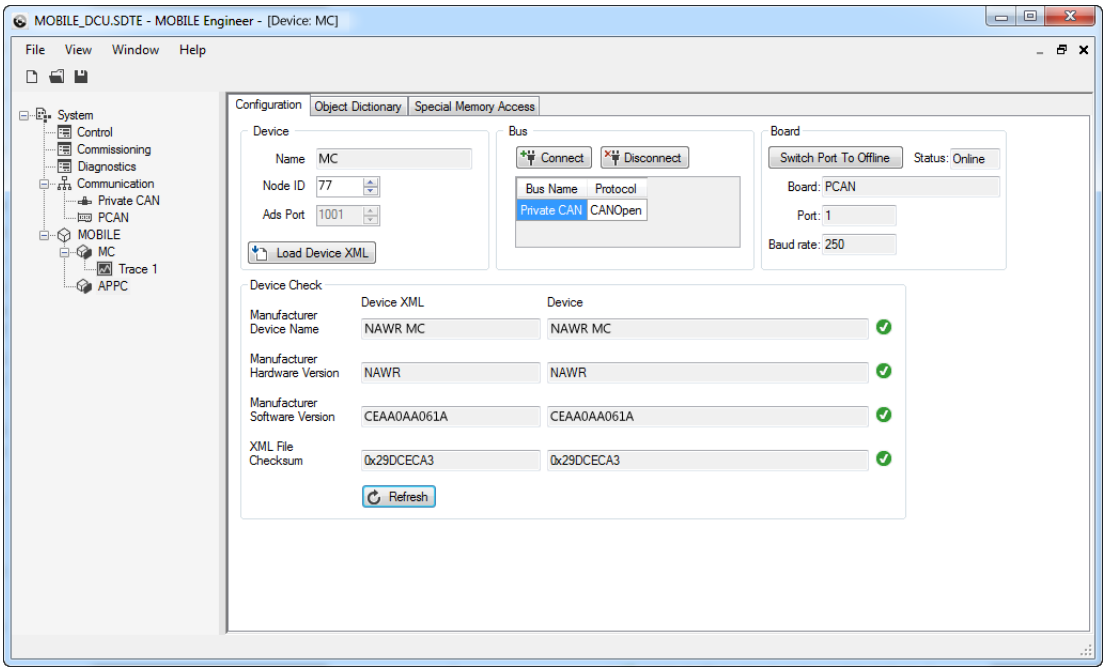


Communication settings for Application Controller (APPC):



Button	Function	
Load Device XML	Load device description file (*.xml) for the Application Controller • The matching device description files are output for every MOBILE firmware release.	
Bus: Connect/Disconnect	Establish/stop connection to the fieldbus	
Board: Switch Port To Offline/Online	Switch PC system bus adapter offline/online	
Device Check: Refresh	When an online connection has been established: Load identification data from the device and compare them with the identification data of the loaded device description file (*.xml)	
		This display indicates that the identification data of the device comply with the identification data of the loaded device description file (*.xml).
		This display indicates that the identification data of the device does not comply with the identification data of the loaded device description file (*.xml). In this case, load the matching device description file (*.xml) or make a firmware update for the device.

Communication settings - Motor Controller (MC):



Button	Function	
Load Device XML	Load device description file (*.xml) for the Motor Controller • The matching device description files are output for every MOBILE firmware release.	
Bus: Connect/Disconnect	Establish/stop connection to the fieldbus	
Board: Switch Port To Offline/Online	Switch PC system bus adapter offline/online	
Device Check: Refresh	When an online connection has been established: Load identification data from the device and compare them with the identification data of the loaded device description file (*.xml)	
		This display indicates that the identification data of the device comply with the identification data of the loaded device description file (*.xml).
		This display indicates that the identification data of the device does not comply with the identification data of the loaded device description file (*.xml). In this case, load the matching device description file (*.xml) or make a firmware update for the device.

5 Application Controller (APPC)

This chapter describes the parameter setting of the Application Controller (APPC).

The functional range differs for each MOBILE device. The table shows the objects described in this chapter and the corresponding functions of the MOBILE devices.

Object	Description		MOBILE			
			DCU	PSU	DCU PSU	DCU S
0x4010	Basic settings		●	●	●	●
		FLX_IN1 ... FLX_IN4	●	●	●	●
		FLX_OUT1 ... FLX_OUT4	●	●	●	
0x4020	Public CAN settings		●	●	●	●
0x4021		Tx ID	●	●	●	●
0x4022		Tx Cycletime	●	●	●	●
0x4023		Rx ID	●	●	●	●
0x4024		Rx Timeout	●	●	●	●
0x4025		Mapping	●	●	●	●
0x4030	Private CAN settings		●	●	●	●
0x4040	Drive Control Unit (DCU) settings	Inverter INV A	●			●
0x4050		Inverter INV B	●		●	
0x4060	Power Supply Unit (PSU) settings	DC/DC converter DCDC		●	●	

5.1 Basic settings

0x4010 - APPC device

Sub.	Name	Default setting	Data type
▸ 0x01	OperationMode	0	UNSIGNED8
▸ 0x02	defaultDcLinkVoltage	0 V	INT16
▸ 0x03	shutdownDelay	1500 ms	UNSIGNED16
▸ 0x04	velocityScalingEnumeration	1	INT8
▸ 0x05	voltagePrechargeDemand	0 V	INT16
▸ 0x10	wakeSourceConfig	2	UNSIGNED16
▸ 0x20	noMcUpdate	0	UNSIGNED8
▸ 0x40	flexIn1Func	0	UNSIGNED16
▸ 0x41	flexIn2Func	0	UNSIGNED16
▸ 0x42	flexIn3Func	1001	UNSIGNED16
▸ 0x43	flexIn4Func	2001	UNSIGNED16
▸ 0x44	flexIn1FuncSwitchOnDelay	0 ms	INT16
▸ 0x45	flexIn2FuncSwitchOnDelay	0 ms	INT16
▸ 0x46	flexIn3FuncSwitchOnDelay	0 ms	INT16
▸ 0x47	flexIn4FuncSwitchOnDelay	0 ms	INT16
▸ 0x48	flexIn1FuncSwitchOffDelay	0 ms	INT16
▸ 0x49	flexIn2FuncSwitchOffDelay	0 ms	INT16
▸ 0x4A	flexIn3FuncSwitchOffDelay	0 ms	INT16

Sub.	Name	Default setting	Data type
▸ 0x4B	flexIn4FuncSwitchOffDelay	0 ms	INT16
▸ 0x50	flexOut1Func	1005	UNSIGNED16
▸ 0x51	flexOut2Func	2005	UNSIGNED16
▸ 0x52	flexOut3Func	1001	UNSIGNED16
▸ 0x53	flexOut4Func	2001	UNSIGNED16

Subindex 0x01: operationMode

0 = control via CAN
1 = stand-alone operation (operated via terminals)

Scaling factor	Setting range	Default setting	Data type
1	0 ... 1	0	UNSIGNED8

Subindex 0x02: defaultDcLinkVoltage

This value is used if the *setp_DcLinkVoltage* setpoint is not available via Public CAN.
If the DC bus functionality is not required, the value 0 V has to be set here.

Scaling factor	Setting range	Default setting	Data type
6.250000000000E-002	-2048 ... 2047.9375 V	0 V	INT16

Subindex 0x03: shutdownDelay

The hardware signal of the terminal 15 is linked to the system status of the terminal 15 ("Clamp15_CAN") received by the master control (see terminal-15-signal). As soon as the resulting signal is missing for the time period set here or longer, the software starts a shutdown.

Scaling factor	Setting range	Default setting	Data type
1	0 ... 65535 ms	1500 ms	UNSIGNED16

Subindex 0x04: velocityScalingEnumeration

-1 = 0.5 rpm/bit
1 = 1 rpm/bit
2 = 2 rpm/bit
3 = 4 rpm/bit

Scaling factor	Setting range	Default setting	Data type
1	-1 ... 4	1	INT8

Subindex 0x05: voltagePrechargeDemand

This function is available as of firmware R6.3.

Scaling factor	Setting range	Default setting	Data type
6.250000000000E-002	0 ... 850 V	0 V	INT16

Subindex 0x10: wakeSourceConfig

Configuration of the source for wake up:
1 = Wake up via CAN
2 = Wake up via terminal 15
3 = Wake up via CAN or terminal 15

Scaling factor	Setting range	Default setting	Data type
1	1 ... 3	2	UNSIGNED16

Subindex 0x20: **noMcUpdate**			
MC firmware update: 0 = enabled 1 = inhibited			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 1	0	UNSIGNED8

Subindex 0x40: **flexIn1Func**			
Function assignment of the FLX_IN1 input (X31/17) • For possible settings, see FLX_IN1 ... FLX_IN4.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 65535	0	UNSIGNED16

Subindex 0x41: **flexIn2Func**			
Function assignment of the FLX_IN2 input (X31/16) • For possible settings, see FLX_IN1 ... FLX_IN4.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 65535	0	UNSIGNED16

Subindex 0x42: **flexIn3Func**			
Function assignment of the FLX_IN3 input (X31/15) • For possible settings, see FLX_IN1 ... FLX_IN4.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 65535	1001	UNSIGNED16

Subindex 0x43: **flexIn4Func**			
Function assignment of the FLX_IN4 input (X31/14) • For possible settings, see FLX_IN1 ... FLX_IN4.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 65535	2001	UNSIGNED16

Subindex 0x44: **flexIn1FuncSwitchOnDelay**			
• By setting a positive delay time, the switch-on command can be delayed via a FLX_IN input. This functionality can be used together with all enable functions. See "Delayed switch-on via an FLX_IN". • By setting a negative delay time, the fault triggering of the monitoring of a FLX_IN input can be delayed. This functionality can only be used for the FLX_IN function "On fault response", otherwise this configuration has no effect. See "Delayed monitoring via an FLX_IN".			
Scaling factor	Setting range	Default setting	Data type
1	-32768 ... 32767 ms	0 ms	INT16

Subindex 0x45: **flexIn2FuncSwitchOnDelay**			
See description to subindex 0x44			
Scaling factor	Setting range	Default setting	Data type
1	-32768 ... 32767 ms	0 ms	INT16

Subindex 0x46: **flexIn3FuncSwitchOnDelay**			
See description to subindex 0x44			
Scaling factor	Setting range	Default setting	Data type
1	-32768 ... 32767 ms	0 ms	INT16

Subindex 0x47: **flexIn4FuncSwitchOnDelay**			
See description to subindex 0x44			
Scaling factor	Setting range	Default setting	Data type
1	-32768 ... 32767 ms	0 ms	INT16

Subindex 0x48: **flexIn1FuncSwitchOffDelay**			
By setting a positive delay time, the switch-off command can be delayed via a FLX_IN input. See "Delayed switch-off via an FLX_IN".			
Scaling factor	Setting range	Default setting	Data type
1	-32768 ... 32767 ms	0 ms	INT16

Subindex 0x49: **flexIn2FuncSwitchOffDelay**			
By setting a positive delay time, the switch-off command can be delayed via a FLX_IN input. See "Delayed switch-off via an FLX_IN".			
Scaling factor	Setting range	Default setting	Data type
1	-32768 ... 32767 ms	0 ms	INT16

Subindex 0x4A: **flexIn3FuncSwitchOffDelay**			
By setting a positive delay time, the switch-off command can be delayed via a FLX_IN input. See "Delayed switch-off via an FLX_IN".			
Scaling factor	Setting range	Default setting	Data type
1	-32768 ... 32767 ms	0 ms	INT16

Subindex 0x4B: **flexIn4FuncSwitchOffDelay**			
By setting a positive delay time, the switch-off command can be delayed via a FLX_IN input. See "Delayed switch-off via an FLX_IN".			
Scaling factor	Setting range	Default setting	Data type
1	-32768 ... 32767 ms	0 ms	INT16

Subindex 0x50: **flexOut1Func**			
Function assignment of the FLX_OUT1 output (X31/26): • For possible settings, see FLX_OUT1 ... FLX_OUT4.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 65535	1005	UNSIGNED16

Subindex 0x51: **flexOut2Func**			
Function assignment of the FLX_OUT2 output (X31/25) • For possible settings, see FLX_OUT1 ... FLX_OUT4.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 65535	2005	UNSIGNED16

Subindex 0x52: **flexOut3Func**			
Function assignment of the FLX_OUT3 output (X31/24) • For possible settings, see FLX_OUT1 ... FLX_OUT4.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 65535	1001	UNSIGNED16

Subindex 0x53: **flexOut4Func**			
Function assignment of the FLX_OUT4 output (X31/23) • For possible settings, see FLX_OUT1 ... FLX_OUT4.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 65535	2001	UNSIGNED16

5.1.1 FLX_IN1 ... FLX_IN4

Each of the four inputs has one parameter which serves to configure the function of the input:

Input	Parameter	Default setting			
		MOBILE			
		DCU	PSU	DCU PSU	DCU s
FLX_IN1	0x4010:0x40	0	0	0	0
FLX_IN2	0x4010:0x41	0	0	0	0
FLX_IN3	0x4010:0x42	1001	0	0	1001
FLX_IN4	0x4010:0x43	2001	0	2001	0

0: No function
1001: Auto-enable INV A/DCDC (HIGH level)
2001: Auto-enable INV B/DCDC (HIGH level)

Note!

If several inputs are assigned the same function or functions that influence each other, the priority is fixed by the processing sequence of the inputs.

- FLX_IN1: lowest priority
- FLX_IN4: highest priority

5.1.1.1 Possible settings

- Unlisted values do not have any function.
- Pull-up active/Pull-down active: The inputs have internal pull-up and pull-down resistors which can be activated. Depending on the selected function, they will be activated automatically.

Value	Function	Level	Pull-up active	Pull-down active	Comments
0	No function				
Control signals for device					
1	Auto enable device	High	●		Without external wiring active Stop is possible via signal
2	Enable device	High		●	Without external wiring inactive
3		Low	●		
4	With a fault response “Quick stop" INV A/INV B	High	●		Without external wiring active
5		Low		●	
6	With a fault response "Coast" INV A/INV B	High	●		Without external wiring active
7		Low		●	
8	Precharge enable, DC link	High		●	(This function is available as of firmware R6.4.) To activate the precharge, all configured FlexIn[x]Func must be activated. ▸ Precharge via FLX_INx (📖 90)
9		Low	●		
10	Restore parameter set 1 INV A/INV B	High		●	
11		Low		●	
12	Restore parameter set 2 INV A/INV B	High		●	
13		Low		●	
14	Restore parameter set 3 INV A/INV B	High		●	
15		Low		●	
16	Restore parameter set 4 INV A/INV B	High		●	
17		Low		●	
18	Restore parameter set 5 INV A/INV B	High		●	
19		Low		●	
20	Restore parameter set 6 INV A/INV B	High		●	
21		Low		●	
22	Restore parameter set 7 INV A/INV B	High		●	
23		Low		●	
24	Restore parameter set 8 INV A/INV B	High		●	
25		Low		●	
26	Restore parameter set 9 INV A/INV B	High		●	
27		Low		●	
28	Restore parameter set 10 INV A/INV B	High		●	
29		Low		●	
30	Restore parameter set 11 INV A/INV B	High		●	
31		Low		●	
32	Restore parameter set 12 INV A/INV B	High		●	
33		Low		●	
34	Restore parameter set 13 INV A/INV B	High		●	
35		Low		●	

Value	Function	Level	Pull-up active	Pull-down active	Comments
36	Restore parameter set 14 INV A/INV B	High		●	
37		Low		●	
40	Discharge enable, DC link	High		●	(This function is available as of firmware R6.4.) The discharge is deactivated if no FlexIn[x]Func with this function is configured and OperationMode = 1 (stand-alone operation). ▸ Discharge function (📖 93)
41		Low	●		
Control signals for INV A/DCDC					
1001	Auto-enable INV A/DCDC	High	●		Without external wiring active Stop is possible via signal
1002	Enable INV A/DCDC	High		●	Without external wiring inactive
1003		Low	●		
1004	Selection of preset setpoints INV A	High		●	Without external wiring inactive ▸ Selection of fixed setpoints (📖 52)
1005		Low	●		
1006	With a fault response “Quick stop" INV A	High	●		Without external wiring active
1007		Low		●	
1008	With a fault response "Coast" INV A	High	●		Without external wiring active
1009		Low		●	
Control signals for INV B					
2001	Auto enable INV B	High	●		Without external wiring active Stop is possible via signal
2002	Enable INV B	High		●	Without external wiring inactive
2003		Low	●		
2004	Selection of preset setpoints INV B	High		●	Without external wiring inactive ▸ Selection of fixed setpoints (📖 52)
2005		Low	●		
2006	With a fault response "Quick stop" INV B	High	●		Without external wiring active
2007		Low		●	
2008	With a fault response "Coast" INV B	High	●		Without external wiring active
2009		Low		●	

5.1.1.2 Selection of fixed setpoints

In stand-alone operation (0x4010:0x01) you can select up to 16 predefined speeds or torques with the inputs FLX_IN1 ... FLX_IN4.

Either the speed setpoints or the torque setpoints are available depending on the operating mode that is selected:

Operating mode		MOBILE			
		DCU	PSU	DCU PSU	DCU s
Velocity Mode Torque mode	INV A: (0x6060)	●			●
Velocity Mode Torque mode	INV B: (0x6860)	●		●	

Velocity Mode: presetSpeedSetp1 ... presetSpeedSetp16

Torque Mode: presetTorqueSetp1 ... presetTorqueSetp16

Fixed setpoint				inputs			
presetSpeedSetp		presetTorqueSetp		FLX_IN4	FLX_IN3	FLX_IN2	FLX_IN1
INV A: 0x4040 INV B: 0x4050	Sub	INV A: 0x4040 INV B: 0x4050	Sub				
1	0x31	1	0x41	0	0	0	0
2	0x32	2	0x42	0	0	0	1
3	0x33	3	0x43	0	0	1	0
4	0x34	4	0x44	0	0	1	1
5	0x35	5	0x45	0	1	0	0
6	0x36	6	0x46	0	1	0	1
7	0x37	7	0x47	0	1	1	0
8	0x38	8	0x48	0	1	1	1
9	0x39	9	0x49	1	0	0	0
10	0x3A	10	0x4A	1	0	0	1
11	0x3B	11	0x4B	1	0	1	0
12	0x3C	12	0x4C	1	0	1	1
13	0x3D	13	0x4D	1	1	0	0
14	0x3E	14	0x4E	1	1	0	1
15	0x3F	15	0x4F	1	1	1	0
16	0x40	16	0x50	1	1	1	1

- If the defined setpoint = 0, the power section is switched off.
- The control signals for the inputs FLX_IN1 ... FLX_IN4 can be configured:
  - Possible settings (📖 50)

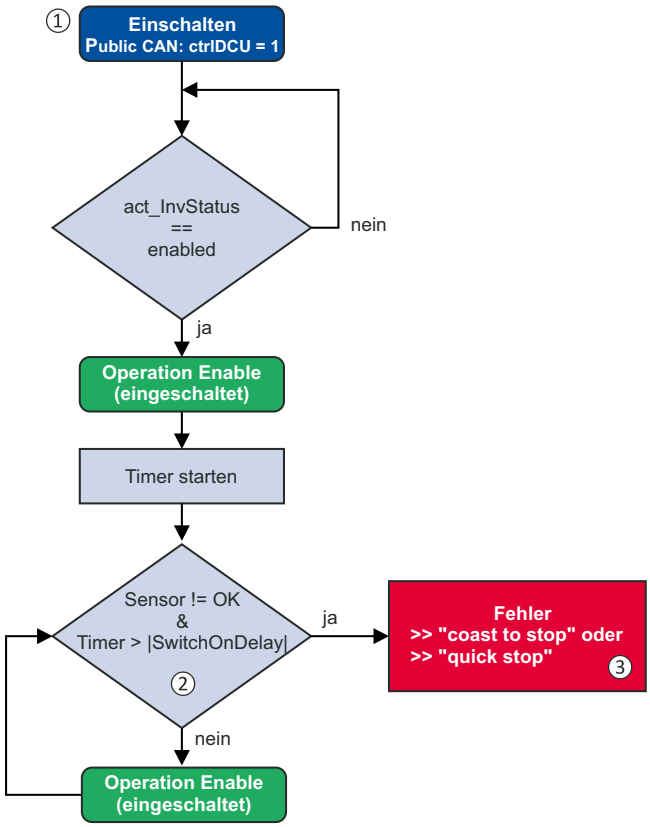
5.1.1.3 Delayed monitoring of an FLX_IN

This functionality is used to monitor a pressure sensor that must first build up pressure after the compressor is switched on. For this reason, it must be monitored with a delay.

Parameterization of this functionality:

Input	Parameter	setting
FLX_IN1	0x4010:0x40	**Function assignment:** For the input used configure to • In case of a fault "Quickstop" response" or • In case of a fault "Coasting" response.
FLX_IN2	0x4010:0x41	
FLX_IN3	0x4010:0x42	
FLX_IN4	0x4010:0x43	
FLX_IN1	0x4010:0x44	**SwitchOnDelay:** Set a **negative** delay time for the input used to delay the error triggering of monitoring.
FLX_IN2	0x4010:0x45	
FLX_IN3	0x4010:0x46	
FLX_IN4	0x4010:0x47	

Sequence diagram



✍	In stand-alone mode, switch-on takes place via FLEX_IN
↓	**Sensor**: Sensor to be monitored at the correspondingly configured input. **SwitchOnDelay**: Delay time set for the input used.
↳	Response according to the function assignment set for the input used.

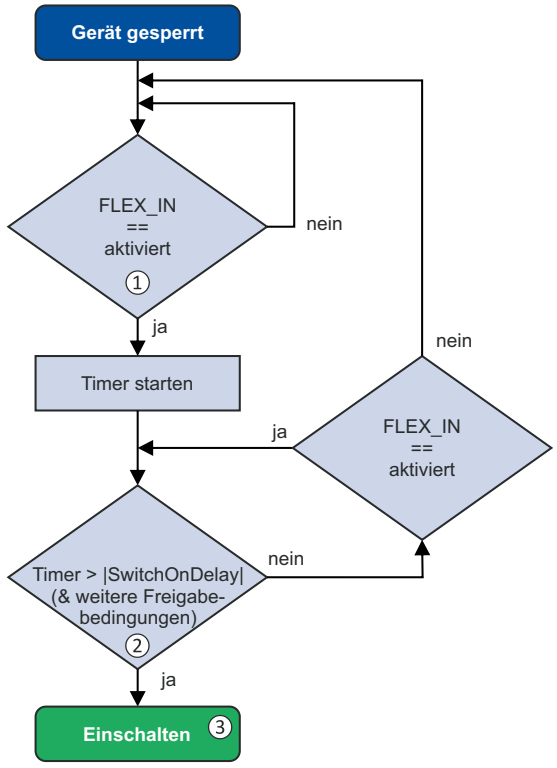
5.1.1.4 Delayed switch-on via an FLX_IN

With this functionality the switch-on command can be delayed, which is done via a FLX_IN.

Parameterization of this functionality:

Input	Parameter	setting
FLX_IN1	0x4010:0x40	**Function assignment:** Configure to "Enable device" for the input used.
FLX_IN2	0x4010:0x41	
FLX_IN3	0x4010:0x42	
FLX_IN4	0x4010:0x43	
FLX_IN1	0x4010:0x44	**SwitchOnDelay:** Set a **positive** delay time to delay the switch-on command.
FLX_IN2	0x4010:0x45	
FLX_IN3	0x4010:0x46	
FLX_IN4	0x4010:0x47	

Sequence diagram



✍	**FLEX_IN**: Input used for "Enable device" and configured accordingly.
↓	**SwitchOnDelay**: Delay time set for the input used.
↳	Switch-on only occurs when all switch-on conditions are fulfilled: • Terminal 15 signal available. • No error is pending.

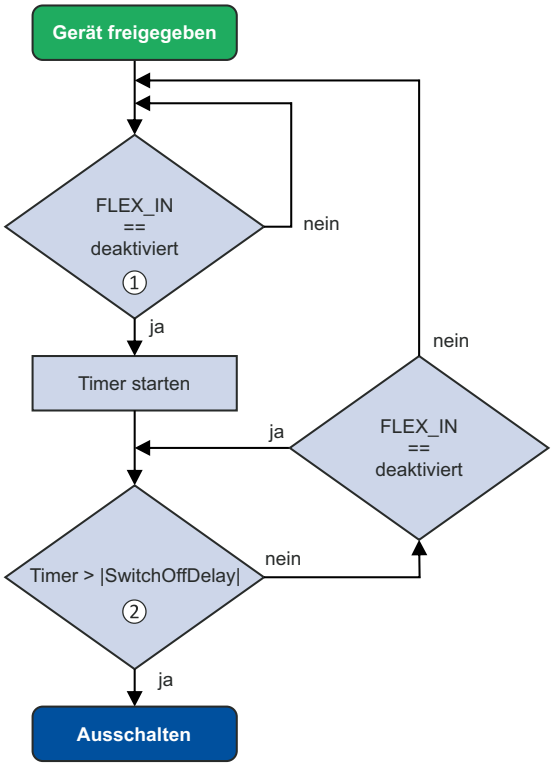
5.1.1.5 Delayed switch-off via an FLX_IN

With this functionality the switch-off command can be delayed, which is done via a FLX_IN.

Parameterization of this functionality:

Input	Parameter	setting
FLX_IN1	0x4010:0x40	**Function assignment:** Configure to "Enable device" for the input used.
FLX_IN2	0x4010:0x41	
FLX_IN3	0x4010:0x42	
FLX_IN4	0x4010:0x43	
FLX_IN1	0x4010:0x48	**SwitchOffDelay:** Set a **positive** delay time to delay the switch-off command.
FLX_IN2	0x4010:0x49	
FLX_IN3	0x4010:0x4A	
FLX_IN4	0x4010:0x4B	

Sequence diagram



✍	**FLEX_IN**: Input used for "Enable device" and configured accordingly.
↓	**SwitchOffDelay**: Delay time set for the input used.

5.1.2 FLX_OUT1 ... FLX_OUT4

Each of the four outputs has one parameter which serves to configure the function of the output:

Output	Parameter	Default setting			
		MOBILE			
		DCU	PSU	DCU PSU	DCU s
FLX_OUT1	0x4010:0x50	1005	1005	0	1005
FLX_OUT2	0x4010:0x51	2005	0	2005	0
FLX_OUT3	0x4010:0x52	1001	1001	0	1001
FLX_OUT4	0x4010:0x53	2001	0	2001	0

1001: Fault INV A/DCDC (HIGH level)

1005: Power section from INV A/DCDC is switched on (HIGH level)

2001: Fault INV B (HIGH level)

2005: Power section from INV B is switched on (HIGH level)

Possible settings

Unlisted values do not have any function.

Value	Function	active level	Comments
0	No function	-	
Status signals of the device			
1	Fault	High	INV A/DCDC **or** INV B reports an error (red LED1 is permanently on).
2		Low	
3		High	INV A/DCDC **and** INV B report an error (red LED1 is permanently on).
4		Low	
5	Warning or error	High	INV A/DCDC **or** INV B reports an error or warning.
6		Low	
7		High	INV A/DCDC **and** INV B report an error or warning.
8		Low	
9	Device is enabled	High	INV A/DCDC **or** INV B is enabled
10		Low	
11		High	INV A/DCDC **and** INV B are enabled.
12		Low	
13	Device is ready to start	High	INV A/DCDC **or** INV B is ready to start.
14		Low	
15		High	INV A/DCDC **and** INV B are ready to start.
16		Low	
17	Precharge completed	High	Signal can be used, for instance, for triggering the mains contactor. ▸ Precharge function

Value	Function	active level	Comments
Status signals INV A/DCDC			
1001	Fault INV A/DCDC	High	
1002		Low	
1003	Warning or error INV A/ DCDC	High	
1004		Low	
1005	INV A/DCDC is enabled	High	
1006		Low	
1007	INV A/DCDC is ready to start	High	
1008		Low	
Status signals INV B			
2001	Fault INV B	High	
2002		Low	
2003	Warning or error INV B	High	
2004		Low	
2005	INV B is enabled	High	
2006		Low	
2007	INV B is ready to start	High	
2008		Low	

5.2 Automatic fault reset

If a fault occurs in the device, the device switches to a fault state. With the automatic fault reset, the corresponding inverter output (DCU/PSU) is automatically reset to the "Operational Mode" status. The following sub-chapters describe the functions and settings of the automatic fault reset.

5.2.1 Parameter

The following parameters are required for configuring the fault reset. The parameters are each available for inverter A and B (DCU/PSU).

- *mcFaultResetMaskH*
- *mcFaultResetMaskL*
- *mcResetTypeMaskH*
- *mcResetTypeMaskL*
- *mcFaultResetDelayTimer1*
- *mcCounterResetDelayTime1*
- *mcMaxResetNumber1*
- *mcFaultResetDelayTimer2*
- *mcCounterResetDelayTime2*
- *mcMaxResetNumber2*

The parameters are described in these chapters:

▸ Drive Control Unit (DCU) settings (📖 70)
▸ Power Supply Unit (PSU) settings (📖 80)

5.2.2 Setting the fault reset

The automatic fault reset is deactivated by default and is configured using parameters. The configuration is performed with the aid of bits that describe the faults.

The selection of faults that require a fault reset is set using bit masks. The error bits are contained in MC status word 1 and MC status word 2. Meaning of the warning and error bits in the MC status word 1 & 2 (📖 239)

5.2.2.1 Selection of error bits

The parameters *mcFaultResetMask* and *mcResetTypeMask* have two versions each, which are used to select the error bits in MC status word 1 and MC status word 2.

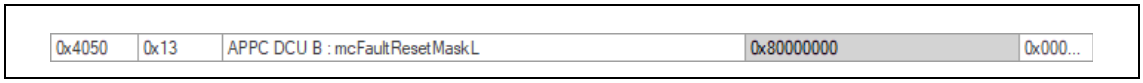
Parameter	Selection of error bits in
mcFaultResetMaskH mcResetTypeMaskH	MC status word 2
mcFaultResetMaskL mcResetTypeMaskL	MC status word 1

5.2.2.2 mcFaultResetMask

mcFaultResetMask is used to activate the fault reset for specific faults. The parameter is assigned the required error bit of the corresponding MC status word.

In the following figure, bit 31 (MOBILE interior temperature has reached fault threshold) of MC status word 1 was configured in parameter *mcFaultResetMaskL*.

As soon as this fault occurs, a fault reset is triggered. Once the fault is no longer pending, the device automatically switches to "Operational Mode".



Tip!

You can configure this function for several faults by assigning several error bits with the aid of the bit mask.

Converting bits

Use the Microsoft calculator in the Windows operating system to simply convert a binary value to a hex value in the "Programmer" function. The reading direction is from right to left, meaning the first number all the way on the right is bit 1.

- Binary value 1: bit activated
- Binary value 0: bit deactivated
- Example:
  You want to activate bit 3 and bit 4. The result is a binary value of "1100". The converted hex value is "0xC". Enter the hex value "0xC" in the parameter.

5.2.2.3 mcResetTypeMask

mcResetTypeMask lets you use two types to determine which parameters to use for the fault reset.

ResetTypeMask	Parameters for the fault reset
Type 1	• MaxResetNumber1 • FaultResetDelay1 • CounterResetDelay1
Type 2	• MaxResetNumber2 • FaultResetDelay2 • CounterResetDelay2

- No value is entered in *mcResetTypeMask*: Parameters assigned to type 1 are used.
- An error bit is entered in *mcResetTypeMask*: Parameters assigned to type 2 are used.

5.2.2.4 mcMaxResetNumber

mcMaxResetNumber sets the number of permitted fault reset attempts. Fault reset attempts can only be repeated when

- the time set in *mcCounterResetDelay* has elapsed without the device being in a fault state or
- a KL15 fault reset was performed or
- a UDS fault reset was performed.

5.2.2.5 mcFaultResetDelayTime

Depending on the setting, the fault reset is repeated until no faults are pending or the maximum number of fault resets has been reached (mcMaxResetNumber).

mcFaultResetDelayTime sets the time between separate fault reset attempts. The time is set in milliseconds.

5.2.2.6 mcCounterResetDelay

mcCounterResetDelay sets the waiting time that must elapse before fault reset attempts are performed again.

- The counter starts when a fault reset was successful or the device is no longer in a fault state.
- If the device enters a fault state during the counter time, the counter is reset.
- Once the counter time has elapsed, automatic fault reset attempts are performed again.

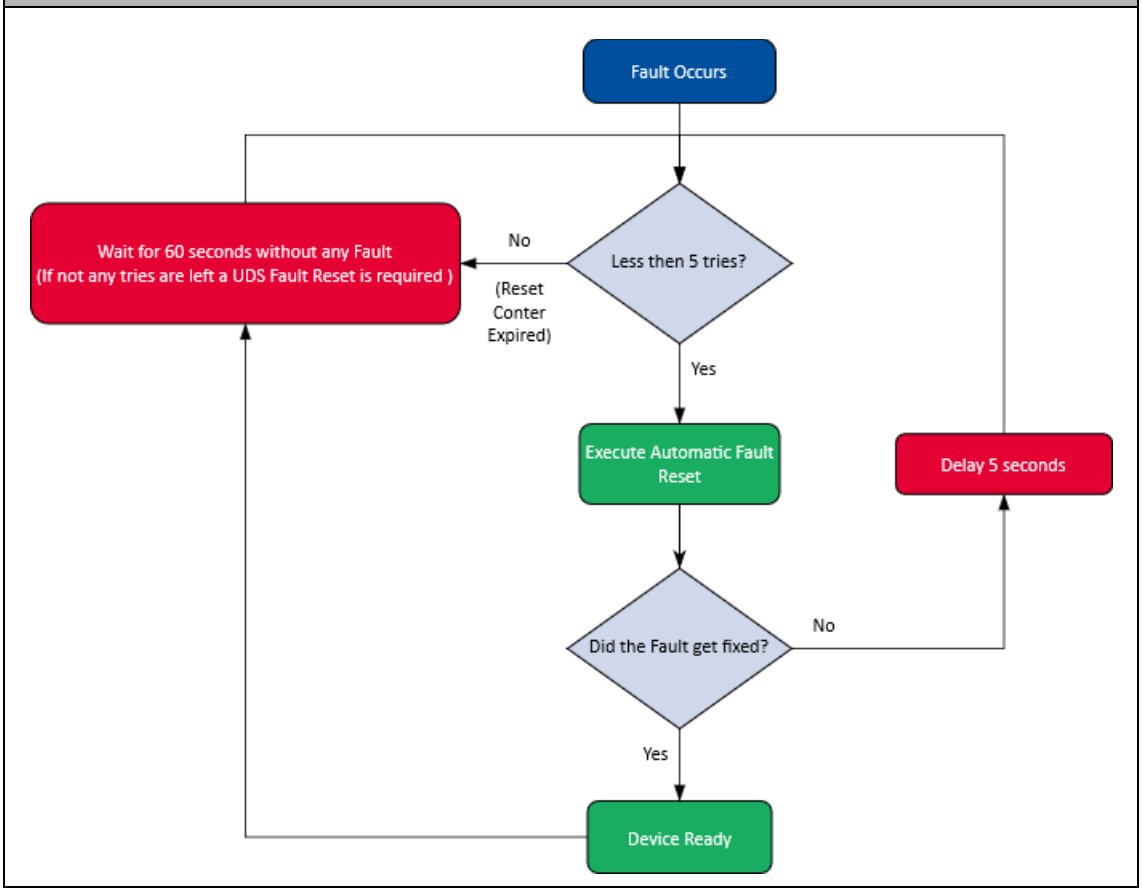
5.2.3 Case example

In this example, the fault "MOBILE interior temperature has reached error threshold" (bit 31) is simulated.

Bit 31 belongs to MC status word 1, to which parameters *mcFaultResetMaskL* and *mcResetTypeMaskL* are assigned.

- In parameter *mcFaultResetMaskL* the hex value "0x80000000" is entered for bit 31.
- No value is entered in parameter *mcResetTypeMaskL*. This means type 1 is assigned.
  Type 1 is used with the default values:
  - Maximum number of 5 fault resets
  - 5 seconds between fault resets
  - 60 seconds after a fault reset was successful or the device has not been in a fault state for the specified time.
- After parameter setting, the automatic fault reset is activated for this fault.

Flow chart for the case example



5.3 Public CAN settings

0x4020 - APPC Public CAN

Sub.	Name	Default setting	Data type
▸ 0x01	baudrate	5	UNSIGNED8
▸ 0x02	baseAddr	234	UNSIGNED8
▸ 0x03	baseAddr XCP APPC	234	UNSIGNED8
▸ 0x04	baseAddr XCP MC	220	UNSIGNED8
▸ 0x20	J1939 DM1 enable	0	UNSIGNED8
▸ 0x21	J1939 DM1 PL config	0x0000	UNSIGNED16
▸ 0x22	J1939 DM1 AWL config	0x0000	UNSIGNED16
▸ 0x23	J1939 DM1 RSL config	0x0000	UNSIGNED16
▸ 0x24	J1939 DM1 MIL config	0x0000	UNSIGNED16
▸ 0x30	enable short circuit monitoring	0	UNSIGNED8

Subindex 0x01: baudrate

Baud rate for Public CAN:
4 = 125 kbps
5 = 250 kbps
6 = 500 kbps
All other settings: 250 kbps

Scaling factor	Setting range	Default setting	Data type
1	4 ... 6	5	UNSIGNED8

Subindex 0x02: baseAddr

Basic address for Public CAN
• The real CAN address consists of the basic address plus the CAN address offset set via the ID pins.
▸ Device identification

Scaling factor	Setting range	Default setting	Data type
1	0 ... 255	234	UNSIGNED8

Scaling factor	Setting range	Default setting	Data type
1	0 ... 255	234	UNSIGNED8

Scaling factor	Setting range	Default setting	Data type
1	0 ... 255	220	UNSIGNED8

Subindex 0x20: J1939 DM1 enable

SAE J1939 diagnostics message DM1:
0 = transmission deactivated
1 = transmission activated
▸ DM1 - Active Diagnostic Trouble Codes

Scaling factor	Setting range	Default setting	Data type
1	0 ... 1	0	UNSIGNED8

Subindex 0x21: **J1939 DM1 PL config**			
SAE J1939 diagnostic message DM1: "Protect Lamp" switch-on criteria (bit value 0 = no, 1 = yes) Bit 0: Error of inverter A Bit 1: Error of inverter B Bit 2: Temporary error of inverter A (auto-error reset active) Bit 3: Temporary error of inverter B (auto-error reset active) Bit 4: Warning of inverter A Bit 5: Warning of inverter B ▸ DM1 - Active Diagnostic Trouble Codes			
Scaling factor	Setting range	Default setting	Data type
1	0x0000 ... 0x003F	0x0000	UNSIGNED16

Subindex 0x22: **J1939 DM1 AWL config**			
SAE J1939 diagnostic message DM1: "Amber Warning Lamp" switch-on criteria (bit value 0 = no, 1 = yes) Bit 0: Error of inverter A Bit 1: Error of inverter B Bit 2: Temporary error of inverter A (auto-error reset active) Bit 3: Temporary error of inverter B (auto-error reset active) Bit 4: Warning of inverter A Bit 5: Warning of inverter B ▸ DM1 - Active Diagnostic Trouble Codes			
Scaling factor	Setting range	Default setting	Data type
1	0x0000 ... 0x003F	0x0000	UNSIGNED16

Subindex 0x23: **J1939 DM1 RSL config**			
SAE J1939 diagnostic message DM1: "Red Stop Lamp" switch-on criteria (bit value 0 = no, 1 = yes) Bit 0: Error of inverter A Bit 1: Error of inverter B Bit 2: Temporary error of inverter A (auto-error reset active) Bit 3: Temporary error of inverter B (auto-error reset active) Bit 4: Warning of inverter A Bit 5: Warning of inverter B ▸ DM1 - Active Diagnostic Trouble Codes			
Scaling factor	Setting range	Default setting	Data type
1	0x0000 ... 0x003F	0x0000	UNSIGNED16

Subindex 0x24: **J1939 DM1 MIL config**			
SAE J1939 diagnostic message DM1: "Malfunction Indicator Lamp" switch-on criteria (bit value 0 = no, 1 = yes) Bit 0: Error of inverter A Bit 1: Error of inverter B Bit 2: Temporary error of inverter A (auto-error reset active) Bit 3: Temporary error of inverter B (auto-error reset active) Bit 4: Warning of inverter A Bit 5: Warning of inverter B ▸ DM1 - Active Diagnostic Trouble Codes			
Scaling factor	Setting range	Default setting	Data type
1	0x0000 ... 0x003F	0x0000	UNSIGNED16

Subindex 0x30: **enable short circuit monitoring**			
Setting "0" = Short circuit monitoring is deactivated. Setting "1" = Short circuit monitoring is deactivated. If monitoring is activated, a DTC warning is issued in the event of a Public CAN short circuit.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 1	0	UNSIGNED8

0x4021 - APPC Public CAN Tx ID

Identifier for the Public CAN transmit messages
- The transmitter address (SA, bit 0 ... 7) is internally overwritten with the real CAN address of the MOBILE.
- PDU format (bit 16 ... 23) is permanently "0xFF" (manufacturer-specific broadcast message).

▸ Parameter groups (PGs): Identifier

Sub.	Name	Default setting	Data type
0x01	msg0	0x18FF00EA	UNSIGNED32
0x02	msg1	0x18FF01EA	UNSIGNED32
0x03	msg2	0x18FF02EA	UNSIGNED32
0x04	msg3	0x18FF03EA	UNSIGNED32
0x05	Flex In Out	0x18FF04EA	UNSIGNED32
0x10	XCP APPC	0x18EFFAF7	UNSIGNED32
0x11	XCP MC	0x18EFFAE9	UNSIGNED32

0x4022 - APPC Public CAN Tx Cycletime

Cycle time for the Public CAN transmit messages
- Setting "0" deactivates the transmission of the corresponding message.

Sub.	Name	Default setting	Data type
0x01	msg0	100 ms	UNSIGNED16
0x02	msg1	100 ms	UNSIGNED16
0x03	msg2	100 ms	UNSIGNED16
0x04	msg3	100 ms	UNSIGNED16
0x05	Flex In Out	0 ms	UNSIGNED16

0x4023 - APPC Public CAN Rx ID

Identifier for the Public CAN receive messages
- As transmitter address (SA, bit 0 ... 7), set the CAN address of the master control (default setting: 0x80 = 128).
- The device number (PDU Specific; bit 12 ... 15) is internally overwritten with the real device number of the MOBILE.
- PDU format (bit 16 ... 23) is permanently "0xFF" (manufacturer-specific broadcast message).

▸ Parameter groups (PGs): Identifier

Sub.	Name	Default setting	Data type
0x01	msg0	0x18FF1080	UNSIGNED32
0x02	msg1	0x18FF1180	UNSIGNED32
0x03	msg2	0x18FF1280	UNSIGNED32
0x04	msg3	0x18FF1380	UNSIGNED32
0x05	Flex In Out	0x18FF1480	UNSIGNED32
0x10	XCP APPC	0x18EFF7FA	UNSIGNED32
0x11	XCP MC	0x18EFE9FA	UNSIGNED32

0x4024 - APPC Public CAN Rx timeout

Timeout time for the Public CAN receive messages
- If "0" is set, the timeout monitoring of the corresponding message is deactivated.

Sub.	Name	Default setting	Data type
0x01	msg0	500 ms	UNSIGNED16
0x02	msg1	500 ms	UNSIGNED16
0x03	msg2	500 ms	UNSIGNED16
0x04	msg3	500 ms	UNSIGNED16
0x05	Flex In Out	0 ms	UNSIGNED16

0x4025 - APPC Public CAN Mapping

Sub.	Name	Default setting	Data type
▸ 0x01	mappingPsuVoltageSignals	0	UNSIGNED8
▸ 0x02	mappedFlexInOutSignal1	0	UNSIGNED16
▸ 0x03	mappedFlexInOutSignal2	0	UNSIGNED16
▸ 0x04	mappingMsg1DcuAByte3And4	0	UNSIGNED16
▸ 0x05	mappingMsg1DcuAByte7	0	UNSIGNED16
▸ 0x06	mappingMsg2DcuBByte3And4	0	UNSIGNED16
▸ 0x07	mappingMsg2DcuBByte7	0	UNSIGNED16
▸ 0x08	mappingMsg3PsuByte7	0	UNSIGNED16

Subindex 0x01: mappingPsuVoltageSignals

Selection old/new mapping for the following Public CAN signals:
- "Setpoints for on-board converter" - signal: "setp_Voltage" (old: byte 4; new: byte 4 - 5)
- "Actual values from on-board converter" - signal: "act_Voltage" (old: byte 1; new: byte 1 - 2)

Setting "0" = new mapping (2 bytes)
Setting "1" = old mapping (1 byte; like release 52 and older)

Scaling factor	Setting range	Default setting	Data type
1	0 ... 255	0	UNSIGNED8

Subindex 0x02: **mappedFlexInOutSignal1**			
All FLX_IN/OUT can be mapped to the "Device status of the MOBILE" message. Only one bit can be set: Setting "1" (bit 0) = FLX_OUT1 Setting "2" (bit 1) = FLX_OUT2 Setting "4" (bit 2) = FLX_OUT3 Setting "8" (bit 3) = FLX_OUT4 Setting "16" (bit 4) = FLX_IN1 Setting "32" (bit 5) = FLX_IN2 Setting "64" (bit 6) = FLX_IN3 Setting "128" (bit 7) = FLX_IN4			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 65535	0	UNSIGNED16

Subindex 0x03: **mappedFlexInOutSignal2**			
All FLX_IN/OUT can be mapped to the "Device status of the MOBILE" message. Only one bit can be set: Setting "1" (bit 0) = FLX_OUT1 Setting "2" (bit 1) = FLX_OUT2 Setting "4" (bit 2) = FLX_OUT3 Setting "8" (bit 3) = FLX_OUT4 Setting "16" (bit 4) = FLX_IN1 Setting "32" (bit 5) = FLX_IN2 Setting "64" (bit 6) = FLX_IN3 Setting "128" (bit 7) = FLX_IN4			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 65535	0	UNSIGNED16

Subindex 0x04: **mappingMsg1DcuAByte3And4**			
Selection of which value is to be mapped in the message "Actual values of motor A" (byte 3 - 4). Setting "0" = Motor A torque actual value (MC-Index 0x6077) Setting "1" = Motor A current actual value (MC-Index 0x6078:0x08)			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 65535	0	UNSIGNED16

Subindex 0x05: **mappingMsg1DcuAByte7**			
Selection of which value is to be mapped in the message "Actual values of motor A" (byte 7). Setting "0" = Motor A: temperature (MC-Index 0x2910:0x05) Setting "1" = Power Module A: temperature (MC-Index 0x2810:0x08)			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 65535	0	UNSIGNED16

Subindex 0x06: **mappingMsg2DcuBByte3And4**			
Selection of which value is to be mapped in the message "Actual values of motor B" (byte 3 - 4). Setting "0" = Motor B torque actual value (MC index 0x6877) Setting "1" = Motor B current actual value (MC-Index 0x6878:0x08)			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 65535	0	UNSIGNED16

Subindex 0x07: **mappingMsg2DcuBByte7**			
Selection of which value is to be mapped in the message "Actual values of motor B" (byte 7). Setting "0" = Motor B: temperature (MC-Index 0x3110:0x05) Setting "1" = Power Module B: temperature (MC index 0x3010:0x08)			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 65535	0	UNSIGNED16

Subindex 0x08: **mappingMsg3PsuByte7**			
Selection of which value is to be mapped in the message "Actual values from on-board converter" (byte 7). Setting "0" = DC Driver: temperature1 (MC index 0x2810:0x08), for the power section Setting "1" = DC Driver: temperature2 (MC index 0x2810:0x09), for the transformer core			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 65535	0	UNSIGNED16

5.4 Private CAN settings

0x4030 - APPC Private CAN

Sub.	Name	Default setting	Data type
▸ 0x01	baudrate	5	UNSIGNED8
▸ 0x02	baseAddrAppc	32	UNSIGNED8
▸ 0x03	baseAddrMc	1	UNSIGNED8
▸ 0x04	disable	0	UNSIGNED8
▸ 0x05	cycleTimeSetpoints	20	UNSIGNED16
▸ 0x06	cycleTimeTimestamp	20	UNSIGNED16

Subindex 0x01: baudrate

Baud rate for Private CAN:
4 = 125 kbps
5 = 250 kbps
6 = 500 kbps
8 = 1 Mbps
All other settings: 250 kbps

Scaling factor	Setting range	Default setting	Data type
1	0 ... 255	5	UNSIGNED8

Subindex 0x02: baseAddrAppc

Basic address (Private CAN) of the Application Controller (AppC)
- The real CAN address consists of the basic address plus the CAN address offset set via the ID pins.

▸ Device identification

Scaling factor	Setting range	Default setting	Data type
1	1 ... 115	32	UNSIGNED8

Subindex 0x03: baseAddrMc

Basic address (Private CAN) of the Motor Controller (MC)
- The real CAN address for channel 1 consists of the basic address plus the CAN address offset set via the ID pins.
- The CAN address for channel 2 has a fixed offset of 63 to the CAN address for channel 1.

▸ Device identification

Scaling factor	Setting range	Default setting	Data type
1	1 ... 50	1	UNSIGNED8

Subindex 0x04: disable

Activate / deactivate private CAN
0 = private CAN is activated.
1 = private CAN is deactivated.
No terminating resistor is required if the private CAN is deactivated.

Scaling factor	Setting range	Default setting	Data type
1	0 ... 1	0	UNSIGNED8

Subindex 0x05: cycleTimeSetpoints

Scaling factor	Setting range	Default setting	Data type
1	20 ... 1000	20	UNSIGNED16

Subindex 0x06: **cycleTimeTimestamp**			
Scaling factor	Setting range	Default setting	Data type
1	20 ... 1000	20	UNSIGNED16

5.5 Drive Control Unit (DCU) settings

0x4040 | 0x4050 - APPC DCU A/B

Danger!

In the default setting of the "useEmcySetp" parameter (subindex 0x05) the motor output continues to be controlled in the event of a CAN timeout!

Sub.	Name	Default setting	Data type
0x01	switchOnDelay	0 ms	UNSIGNED16
0x02	application	0	UNSIGNED8
0x05	useEmcySetp	0	UNSIGNED8
0x06	defaultDcLinkTolerance	0 V	INT16
0x12	mcFaultResetMaskH	0x00000000	UNSIGNED32
0x13	mcFaultResetMaskL	0x00000000	UNSIGNED32
0x14	mcResetTypeMaskH	0x00000000	UNSIGNED32
0x15	mcResetTypeMaskL	0x00000000	UNSIGNED32
0x16	mcFaultResetDelayTime1	5000 ms	UNSIGNED16
0x17	mcCounterResetDelayTime1	60000 ms	UNSIGNED32
0x18	mcMaxResetNumber1	5	UNSIGNED8
0x1A	mcFaultResetDelayTime2	100 ms	UNSIGNED16
0x1B	mcCounterResetDelayTime2	10000 ms	UNSIGNED32
0x1C	mcMaxResetNumber2	10	UNSIGNED8
0x20	defaultSpeedSetp	0 rev/min	INT32
0x21	speedOff	50.000976 rev/min	INT32
0x22	torqueOff	2 %	INT16
0x2E	defaultGeneratingPowerLimit	0 %	INT16
0x2F	defaultMotoringPowerLimit	0 %	INT16
0x30	defaultTorqueSetp	0 %	INT16
0x31	presetSpeedSetp1	0 rev/min	INT32
0x32	presetSpeedSetp2	0 rev/min	INT32
0x33	presetSpeedSetp3	0 rev/min	INT32
0x34	presetSpeedSetp4	0 rev/min	INT32
0x35	presetSpeedSetp5	0 rev/min	INT32
0x36	presetSpeedSetp6	0 rev/min	INT32
0x37	presetSpeedSetp7	0 rev/min	INT32
0x38	presetSpeedSetp8	0 rev/min	INT32
0x39	presetSpeedSetp9	0 rev/min	INT32
0x3A	presetSpeedSetp10	0 rev/min	INT32
0x3B	presetSpeedSetp11	0 rev/min	INT32
0x3C	presetSpeedSetp12	0 rev/min	INT32
0x3D	presetSpeedSetp13	0 rev/min	INT32
0x3E	presetSpeedSetp14	0 rev/min	INT32
0x3F	presetSpeedSetp15	0 rev/min	INT32
0x40	presetSpeedSetp16	0 rev/min	INT32

Sub.	Name	Default setting	Data type
▸ 0x41	presetTorqueSetp1	0 %	INT32
▸ 0x42	presetTorqueSetp2	0 %	INT32
▸ 0x43	presetTorqueSetp3	0 %	INT32
▸ 0x44	presetTorqueSetp4	0 %	INT32
▸ 0x45	presetTorqueSetp5	0 %	INT32
▸ 0x46	presetTorqueSetp6	0 %	INT32
▸ 0x47	presetTorqueSetp7	0 %	INT32
▸ 0x48	presetTorqueSetp8	0 %	INT32
▸ 0x49	presetTorqueSetp9	0 %	INT32
▸ 0x4A	presetTorqueSetp10	0 %	INT32
▸ 0x4B	presetTorqueSetp11	0 %	INT32
▸ 0x4C	presetTorqueSetp12	0 %	INT32
▸ 0x4D	presetTorqueSetp13	0 %	INT32
▸ 0x4E	presetTorqueSetp14	0 %	INT32
▸ 0x4F	presetTorqueSetp15	0 %	INT32
▸ 0x50	presetTorqueSetp16	0 %	INT32

Subindex 0x01: switchOnDelay

Switch-on delay
- By setting a switch-on delay, the consumers can be switched on in a scaled manner. The switch-on delay is started as soon as all enable conditions are available. ▸ Controller enable
- In case of the "power socket" application, this time is multiplied by the CAN address offset set via the ID pins. ▸ Device identification

Scaling factor	Setting range	Default setting	Data type
1	0 ... 65535 ms	0 ms	UNSIGNED16

Subindex 0x02: application

Selection of the application:
0 = motor (Velocity Mode)
1 = generator
3 = power socket
4 = motor (Torque Mode)
other values = no application

Scaling factor	Setting range	Default setting	Data type
1	0 ... 255	0	UNSIGNED8

Subindex 0x05: useEmcySetp

Behaviour if a reception message is missing longer than the set timeout time:
0 = use the last received setpoint
1 = use emergency setpoints:
- *defaultDcLinkVoltage* (0x4010:0x02)
- *defaultDcLinkTolerance* (subindex 0x06)
- *defaultSpeedSetp* (Subindex 0x20)
- *defaultTorqueSetp* (Subindex 0x30)

2 = switch off

Scaling factor	Setting range	Default setting	Data type
1	0 ... 2	0	UNSIGNED8

Subindex 0x06: **defaultDcLinkTolerance**			
This value is used if the *setp_DcLinkTolerance* setpoint is not available via Public CAN. If the DC bus functionality is not required, 0 V has to be set here.			
Scaling factor	Setting range	Default setting	Data type
6.250000000000E-002	-2048 ... 2047.9375 V	0 V	INT16

Subindex 0x12: **mcFaultResetMaskH**			
Bit mask for defining the resettable error messages of the Motor Controller Bit x = 0 → error bit x in the MC status word 2 cannot be reset Bit x = 1 → error bit x in the MC status word 2 cannot be reset			
Scaling factor	Setting range	Default setting	Data type
1	0x00000000 ... 0xFFFFFFFF	0x00000000	UNSIGNED32

Subindex 0x13: **mcFaultResetMaskL**			
Bit mask for defining the resettable error messages of the Motor Controller Bit x = 0 → error bit x in the MC status word 1 cannot be reset Bit x = 1 → error bit x in the MC status word 1 cannot be reset			
Scaling factor	Setting range	Default setting	Data type
1	0x00000000 ... 0xFFFFFFFF	0x00000000	UNSIGNED32

Subindex 0x14: **mcResetTypeMaskH**			
Bit mask for defining the error type of the error messages of the Motor Controller Bit x = 0 → error bit x in the MC status word 2 is of error type 1 Bit x = 1 → error bit x in the MC status word 2 is of error type 2			
Scaling factor	Setting range	Default setting	Data type
1	0x00000000 ... 0xFFFFFFFF	0x00000000	UNSIGNED32

Subindex 0x15: **mcResetTypeMaskL**			
Bit mask for defining the error type of the error messages of the Motor Controller Bit x = 0 → error bit x in the MC status word 1 is of error type 1 Bit x = 1 → error bit x in the MC status word 1 is of error type 2			
Scaling factor	Setting range	Default setting	Data type
1	0x00000000 ... 0xFFFFFFFF	0x00000000	UNSIGNED32

Subindex 0x16: **mcFaultResetDelayTime1**			
Time period after which error messages of error type 1 can be reset.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 65535 ms	5000 ms	UNSIGNED16

Subindex 0x17: **mcCounterResetDelayTime1**			
Time period after which the counter for error messages of error type 1 is reset.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 4294967295 ms	60000 ms	UNSIGNED32

Subindex 0x18: **mcMaxResetNumber1**			
Maximum number of possible error resets within the time period set in the 0x17 subindex			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 255	5	UNSIGNED8

Subindex 0x1A: **mcFaultResetDelayTime2**			
Time period after which error messages of error type 2 can be reset.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 65535 ms	100 ms	UNSIGNED16

Subindex 0x1B: **mcCounterResetDelayTime2**			
Time period after which the counter for error messages of error type 2 is reset.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 4294967295 ms	10000 ms	UNSIGNED32

Subindex 0x1C: **mcMaxResetNumber2**			
Maximum number of possible error resets within the time period set in the 0x1B subindex			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 255	10	UNSIGNED8

Subindex 0x20: **defaultSpeedSetp**			
Speed setpoint for "stand-alone operation" or emergency speed setpoint • This value is used as emergency speed setpoint if the *setp_Speed* setpoint is not available in case of control via Public CAN and the value "1" is set in 0x05.			
Scaling factor	Setting range	Default setting	Data type
6.103515625000E-005	-131072 ... 131072 rev/min	0 rev/min	INT32

Subindex 0x21: **speedOff**			
When the inverter is switched off, the power section will only be switched off if the current speed has fallen below the speed set here. • The exact behaviour depends on the application.			
Scaling factor	Setting range	Default setting	Data type
6.103515625000E-005	-131072 ... 131072 rev/min	50.000976 rev/min	INT32

Subindex 0x22: **torqueOff**			
When the inverter is switched off, the power section will only be switched off if the current torque has fallen below the torque set here. • The exact behaviour depends on the application.			
Scaling factor	Setting range	Default setting	Data type
0.1	-3276.8 ... 3276.700000 %	2 %	INT16

Subindex 0x2E: **defaultGeneratingPowerLimit**			
Scaling factor	Setting range	Default setting	Data type
0.1	0 ... 3276.700000 %	0 %	INT16

Subindex 0x2F: **defaultMotoringPowerLimit**			
Scaling factor	Setting range	Default setting	Data type
0.1	0 ... 3276.700000 %	0 %	INT16

Subindex 0x30: **defaultTorqueSetp**			
Torque setpoint for "stand-alone operation" or emergency torque setpoint • This value is used as emergency torque setpoint if the *setp_Torque* setpoint is not available in case of control via Public CAN and the value "1" is set in 0x05.			
Scaling factor	Setting range	Default setting	Data type
0.1	-3276.8 ... 3276.700000 %	0 %	INT16

Subindex 0x31: **presetSpeedSetp1**			
Speed specification for preset setpoint 1 • In the Velocity_Mode operating mode, the speed setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
6.103515625000E-005	-131072 ... 131072 rev/min	0 rev/min	INT32

Subindex 0x32: **presetSpeedSetp2**			
Speed specification for preset setpoint 2 • In the Velocity_Mode operating mode, the speed setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
6.103515625000E-005	-131072 ... 131072 rev/min	0 rev/min	INT32

Subindex 0x33: **presetSpeedSetp3**			
Speed specification for preset setpoint 3 • In the Velocity_Mode operating mode, the speed setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
6.103515625000E-005	-131072 ... 131072 rev/min	0 rev/min	INT32

Subindex 0x34: **presetSpeedSetp4**			
Speed specification for preset setpoint 4 • In the Velocity_Mode operating mode, the speed setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
6.103515625000E-005	-131072 ... 131072 rev/min	0 rev/min	INT32

Subindex 0x35: **presetSpeedSetp5**			
Speed specification for preset setpoint 5 • In the Velocity_Mode operating mode, the speed setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
6.103515625000E-005	-131072 ... 131072 rev/min	0 rev/min	INT32

Subindex 0x36: **presetSpeedSetp6**			
Speed specification for preset setpoint 6 • In the Velocity_Mode operating mode, the speed setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
6.103515625000E-005	-131072 ... 131072 rev/min	0 rev/min	INT32

Subindex 0x37: **presetSpeedSetp7**			
Speed specification for preset setpoint 7 • In the Velocity_Mode operating mode, the speed setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
6.103515625000E-005	-131072 ... 131072 rev/min	0 rev/min	INT32

Subindex 0x38: **presetSpeedSetp8**			
Speed specification for preset setpoint 8 • In the Velocity_Mode operating mode, the speed setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
6.103515625000E-005	-131072 ... 131072 rev/min	0 rev/min	INT32

Subindex 0x39: **presetSpeedSetp9**			
Speed specification for preset setpoint 9 • In the Velocity_Mode operating mode, the speed setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
6.103515625000E-005	-131072 ... 131072 rev/min	0 rev/min	INT32

Subindex 0x3A: **presetSpeedSetp10**			
Speed specification for preset setpoint 10 • In the Velocity_Mode operating mode, the speed setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
6.103515625000E-005	-131072 ... 131072 rev/min	0 rev/min	INT32

Subindex 0x3B: **presetSpeedSetp11**			
Speed specification for preset setpoint 11 • In the Velocity_Mode operating mode, the speed setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
6.103515625000E-005	-131072 ... 131072 rev/min	0 rev/min	INT32

Subindex 0x3C: **presetSpeedSetp12**			
Speed specification for preset setpoint 12 • In the Velocity_Mode operating mode, the speed setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
6.103515625000E-005	-131072 ... 131072 rev/min	0 rev/min	INT32

Subindex 0x3D: **presetSpeedSetp13**			
Speed specification for preset setpoint 13 • In the Velocity_Mode operating mode, the speed setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
6.103515625000E-005	-131072 ... 131072 rev/min	0 rev/min	INT32

Subindex 0x3E: **presetSpeedSetp14**			
Speed specification for preset setpoint 14 • In the Velocity_Mode operating mode, the speed setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
6.103515625000E-005	-131072 ... 131072 rev/min	0 rev/min	INT32

Subindex 0x3F: **presetSpeedSetp15**			
Speed specification for preset setpoint 15 • In the Velocity_Mode operating mode, the speed setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
6.103515625000E-005	-131072 ... 131072 rev/min	0 rev/min	INT32

Subindex 0x40: **presetSpeedSetp16**			
Speed specification for preset setpoint 16 • In the Velocity_Mode operating mode, the speed setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
6.103515625000E-005	-131072 ... 131072 rev/min	0 rev/min	INT32

Subindex 0x41: **presetTorqueSetp1**			
Torque selection for preset setpoint 1 • In the Profile Torque Mode operating mode, the torque setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
0.1	-3276.8 ... 3276.700000 %	0 %	INT32

Subindex 0x42: **presetTorqueSetp2**			
Torque selection for preset setpoint 2 • In the Profile Torque Mode operating mode, the torque setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
0.1	-3276.8 ... 3276.700000 %	0 %	INT32

Subindex 0x43: **presetTorqueSetp3**			
Torque selection for preset setpoint 3 • In the Profile Torque Mode operating mode, the torque setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
0.1	-3276.8 ... 3276.700000 %	0 %	INT32

Subindex 0x44: **presetTorqueSetp4**			
Torque selection for preset setpoint 4 • In the Profile Torque Mode operating mode, the torque setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
0.1	-3276.8 ... 3276.700000 %	0 %	INT32

Subindex 0x45: **presetTorqueSetp5**			
Torque selection for preset setpoint 5 • In the Profile Torque Mode operating mode, the torque setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
0.1	-3276.8 ... 3276.700000 %	0 %	INT32

Subindex 0x46: **presetTorqueSetp6**			
Torque selection for preset setpoint 6 • In the Profile Torque Mode operating mode, the torque setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
0.1	-3276.8 ... 3276.700000 %	0 %	INT32

Subindex 0x47: **presetTorqueSetp7**			
Torque selection for preset setpoint 7 • In the Profile Torque Mode operating mode, the torque setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
0.1	-3276.8 ... 3276.700000 %	0 %	INT32

Subindex 0x48: **presetTorqueSetp8**			
Torque selection for preset setpoint 8 • In the Profile Torque Mode operating mode, the torque setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
0.1	-3276.8 ... 3276.700000 %	0 %	INT32

Subindex 0x49: **presetTorqueSetp9**			
Torque selection for preset setpoint 9 • In the Profile Torque Mode operating mode, the torque setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
0.1	-3276.8 ... 3276.700000 %	0 %	INT32

Subindex 0x4A: **presetTorqueSetp10**			
Torque selection for preset setpoint 10 • In the Profile Torque Mode operating mode, the torque setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
0.1	-3276.8 ... 3276.700000 %	0 %	INT32

Subindex 0x4B: **presetTorqueSetp11**			
Torque selection for preset setpoint 11 • In the Profile Torque Mode operating mode, the torque setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
0.1	-3276.8 ... 3276.700000 %	0 %	INT32

Subindex 0x4C: **presetTorqueSetp12**			
Torque selection for preset setpoint 12 • In the Profile Torque Mode operating mode, the torque setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
0.1	-3276.8 ... 3276.700000 %	0 %	INT32

Subindex 0x4D: **presetTorqueSetp13**			
Torque selection for preset setpoint 13 • In the Profile Torque Mode operating mode, the torque setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
0.1	-3276.8 ... 3276.700000 %	0 %	INT32

Subindex 0x4E: **presetTorqueSetp14**			
Torque selection for preset setpoint 14 • In the Profile Torque Mode operating mode, the torque setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
0.1	-3276.8 ... 3276.700000 %	0 %	INT32

Subindex 0x4F: **presetTorqueSetp15**			
Torque selection for preset setpoint 15 • In the Profile Torque Mode operating mode, the torque setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
0.1	-3276.8 ... 3276.700000 %	0 %	INT32

Subindex 0x50: **presetTorqueSetp16**			
Torque selection for preset setpoint 16 • In the Profile Torque Mode operating mode, the torque setpoint is selected via the inputs FLX_IN (configuration of the inputs FLX_IN1 ... FLX_IN4).			
Scaling factor	Setting range	Default setting	Data type
0.1	-3276.8 ... 3276.700000 %	0 %	INT32

5.5.1 Selection of the application:

The application for the inverter can be configured. The following table shows which application can be combined with which motor control process:

Application	Motor/motor control process				
	Asynchronous motor (ASM)			Synchronous motor (PSM)	
	Without encoder		with encoder	Without encoder	with encoder
	SLVFCI	SLVCI	VCI	SLVCS	VCS
Velocity Mode	●	●	●	●	●
Generator Mode	●	●	●	●	●
Power socket	●				
Torque mode		●	●		●

Inverter output:	Legend:	
INV A 0x4040:0x02 INV B 0x4050:0x02	SLVFCI	Sensorless V/f characteristic control for asynchronous motors
	SLVCI	Sensorless vector control for asynchronous motors
	VCI	Vector control for asynchronous motors
	SLVCS	Sensorless vector control for synchronous motors
	VCS	Vector control for synchronous motors

A detailed description of the different motor control modes can be found in the "Overview of the control modes" chapter.

5.6 Power Supply Unit (PSU) settings

0x4060 - APPC PSU A

Sub.	Name	Default setting	Data type
▸ 0x01	switchOnDelay	0 ms	UNSIGNED16
▸ 0x02	application	2	UNSIGNED8
▸ 0x05	useEmcySetp	0	UNSIGNED8
▸ 0x06	defaultDcLinkTolerance	0 V	INT16
▸ 0x12	mcFaultResetMaskH	0x00000000	UNSIGNED32
▸ 0x13	mcFaultResetMaskL	0x00000000	UNSIGNED32
▸ 0x14	mcResetTypeMaskH	0x00000000	UNSIGNED32
▸ 0x15	mcResetTypeMaskL	0x00000000	UNSIGNED32
▸ 0x16	mcFaultResetDelayTime1	5000 ms	UNSIGNED16
▸ 0x17	mcCounterResetDelayTime1	60000 ms	UNSIGNED32
▸ 0x18	mcMaxResetNumber1	5	UNSIGNED8
▸ 0x1A	mcFaultResetDelayTime2	100 ms	UNSIGNED16
▸ 0x1B	mcCounterResetDelayTime2	10000 ms	UNSIGNED32
▸ 0x1C	mcMaxResetNumber2	10	UNSIGNED8
▸ 0x20	defaultCurrentSetp	200 A	INT16
▸ 0x30	defaultVoltageSetp	28 V	INT16

Subindex 0x01: switchOnDelay

Switch-on delay
- By setting a switch-on delay, the consumers can be switched on in a scaled manner. The switch-on delay is started as soon as all enable conditions are available. ▸ Controller enable

Scaling factor	Setting range	Default setting	Data type
1	0 ... 65535 ms	0 ms	UNSIGNED16

Subindex 0x02: application

Selection of the application:
2 = Power Supply Unit (PSU)
other values = no application

Scaling factor	Setting range	Default setting	Data type
1	0 ... 255	2	UNSIGNED8

Subindex 0x05: useEmcySetp

Behaviour if a reception message is missing longer than the set timeout time:
0 = use the last received setpoint
1 = use emergency setpoints:
- *defaultDcLinkVoltage* (0x4010:0x02)
- *defaultDcLinkTolerance* (subindex 0x06)
- *defaultCurrentSetp* (subindex 0x20)
- *defaultVoltageSetp* (subindex 0x30)

2 = switch off

Scaling factor	Setting range	Default setting	Data type
1	0 ... 2	0	UNSIGNED8

Subindex 0x06: **defaultDcLinkTolerance**			
This value is used if the *setp_DcLinkTolerance* setpoint is not available via Public CAN. If the DC bus functionality is not required, the minimum value (-2048 V) has to be set here.			
Scaling factor	Setting range	Default setting	Data type
6.250000000000E-002	-2048 ... 2047.9375 V	0 V	INT16

Subindex 0x12: **mcFaultResetMaskH**			
Bit mask for defining the resettable error messages of the Motor Controller Bit x = 0 → error bit x in the MC status word 2 cannot be reset Bit x = 1 → error bit x in the MC status word 2 cannot be reset			
Scaling factor	Setting range	Default setting	Data type
1	0x00000000 ... 0xFFFFFFFF	0x00000000	UNSIGNED32

Subindex 0x13: **mcFaultResetMaskL**			
Bit mask for defining the resettable error messages of the Motor Controller Bit x = 0 → error bit x in the MC status word 1 cannot be reset Bit x = 1 → error bit x in the MC status word 1 cannot be reset			
Scaling factor	Setting range	Default setting	Data type
1	0x00000000 ... 0xFFFFFFFF	0x00000000	UNSIGNED32

Subindex 0x14: **mcResetTypeMaskH**			
Bit mask for defining the error type of the error messages of the Motor Controller Bit x = 0 → error bit x in the MC status word 2 is of error type 1 Bit x = 1 → error bit x in the MC status word 2 is of error type 2			
Scaling factor	Setting range	Default setting	Data type
1	0x00000000 ... 0xFFFFFFFF	0x00000000	UNSIGNED32

Subindex 0x15: **mcResetTypeMaskL**			
Bit mask for defining the error type of the error messages of the Motor Controller Bit x = 0 → error bit x in the MC status word 1 is of error type 1 Bit x = 1 → error bit x in the MC status word 1 is of error type 2			
Scaling factor	Setting range	Default setting	Data type
1	0x00000000 ... 0xFFFFFFFF	0x00000000	UNSIGNED32

Subindex 0x16: **mcFaultResetDelayTime1**			
Time period after which error messages of error type 1 can be reset.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 65535 ms	5000 ms	UNSIGNED16

Subindex 0x17: **mcCounterResetDelayTime1**			
Time period after which the counter for error messages of error type 1 is reset.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 4294967295 ms	60000 ms	UNSIGNED32

Subindex 0x18: **mcMaxResetNumber1**			
Maximum number of possible error resets within the time period set in 0x17			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 255	5	UNSIGNED8

Subindex 0x1A: **mcFaultResetDelayTime2**			
Time period after which error messages of error type 2 can be reset.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 65535 ms	100 ms	UNSIGNED16

Subindex 0x1B: **mcCounterResetDelayTime2**			
Time period after which the counter for error messages of error type 2 is reset.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 4294967295 ms	10000 ms	UNSIGNED32

Subindex 0x1C: **mcMaxResetNumber2**			
Maximum number of possible error resets within the time period set in 0x1B			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 255	10	UNSIGNED8

Subindex 0x20: **defaultCurrentSetp**			
Maximum output current for DC/DC converter in "stand-alone operation" or emergency maximum setpoint current • This value is used as emergency torque setpoint if the *setp_MaxCurrent* setpoint is not available in case of control via Public CAN and the value "1" is set in 0x05.			
Scaling factor	Setting range	Default setting	Data type
1.562500000000E-002	0 ... 511.984375 A	200 A	INT16

Subindex 0x30: **defaultVoltageSetp**			
Voltage setpoint for DC/DC converter in "stand-alone operation" or emergency voltage setpoint • This value is used as emergency voltage setpoint if the *setp_Voltage* setpoint is not available in case of control via Public CAN and the value "1" is set in 0x05.			
Scaling factor	Setting range	Default setting	Data type
1.953125000000E-003	0 ... 63.998046 V	28 V	INT16

6 Motor Controller (MC)

This chapter describes the parameter setting of the Motor Controller (MC).

6.1 Communication objects

Objects described in this chapter and their availability for the MOBILE devices:

Object	Name	MOBILE			
		DCU	PSU	DCU PSU	DCU S
0x1400	Receive PDO Communication Parameter 1	●	●	●	●
0x1401	Receive PDO Communication Parameter 2	●	●	●	●
0x1402	Receive PDO Communication Parameter 3	●	●	●	
0x1403	Receive PDO Communication Parameter 4	●	●	●	
0x1404	Receive PDO Communication Parameter 5	●	●	●	●
0x1800	Transmit PDO Communication Parameter 1	●	●	●	●
0x1801	Transmit PDO Communication Parameter 2	●	●	●	●
0x1802	Transmit PDO Communication Parameter 3	●	●	●	●
0x1803	Transmit PDO Communication Parameter 4	●	●	●	●
0x1804	Transmit PDO Communication Parameter 5	●	●	●	
0x1805	Transmit PDO Communication Parameter 6	●	●	●	
0x1806	Transmit PDO Communication Parameter 7	●	●	●	

0x1400 ... 0x1404 - Receive PDO Communication Parameter 1 ... 5

Index	Name	Default setting		Data type
		DCU/DCU	PSU/DCU	
0x1400:0x05	Receive PDO Comm. Parameter 1: Event Timer	100 ms	100 ms	UNSIGNED16
0x1401:0x05	Receive PDO Comm. Parameter 2: Event Timer	100 ms	0	UNSIGNED16
0x1402:0x05	Receive PDO Comm. Parameter 3: Event Timer	100 ms	100 ms	UNSIGNED16
0x1403:0x05	Receive PDO Comm. Parameter 4: Event Timer	100 ms	100 ms	UNSIGNED16
0x1404:0x05	Receive PDO Comm. Parameter 5: Event Timer	100 ms	100 ms	UNSIGNED16

0x1800 ... 0x1806 - Transmit PDO Communication Parameter 1 ... 7

Index	Name	Default setting		Data type
		DCU/DCU	PSU/DCU	
0x1800:0x05	Transmit PDO Comm. Parameter 1: Event Timer	20 ms	20 ms	UNSIGNED16
0x1801:0x05	Transmit PDO Comm. Parameter 2: Event Timer	20 ms	20 ms	UNSIGNED16
0x1802:0x05	Transmit PDO Comm. Parameter 3: Event Timer	20 ms	20 ms	UNSIGNED16
0x1803:0x05	Transmit PDO Comm. Parameter 4: Event Timer	20 ms	20 ms	UNSIGNED16
0x1804:0x05	Transmit PDO Comm. Parameter 5: Event Timer	20 ms	20 ms	UNSIGNED16
0x1805:0x05	Transmit PDO Comm. Parameter 6: Event Timer	20 ms	20 ms	UNSIGNED16
0x1806:0x05	Transmit PDO Comm. Parameter 7: Event Timer	20 ms	20 ms	UNSIGNED16

6.2 Basic settings

Objects described in this chapter and their availability for the MOBILE devices:

Object	Name	MOBILE			
		DCU	PSU	DCU PSU	DCU S
0x2730	Plug Cover	●	●	●	
0x2732	DC Link	●	●	●	●
0x2810	Power Module INV A (Clamping)	●			●
0x3010	Power Module INV B (Clamping)	●		●	
0x2900	Inverter Supervision INV A	●			●
0x3100	Inverter Supervision INV B	●		●	
0x2901	Inverter INV A	●			●
0x3101	Inverter INV B	●		●	

0x2730 - Plug Cover

Subindex 0x05: **config**			
Monitoring of open MOBILE cover: 0 = deactivated 1 = activated **Note:** monitoring is not available for MOBILE DCU S.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 1	1	UNSIGNED16

0x2732 - DC Link

Sub.	Name	Default setting	Data type
▸ 0x07	voltage min	0 V	INT16
▸ 0x0D	voltage ripple max	0 V	INT16

Subindex 0x07: **voltage min**			
Adjustable threshold for monitoring with regard to DC bus undervoltage • If the values fall below the threshold set here, the error bit 12 is set in the MC status word 1. • If the setting is "0", monitoring is deactivated.			
Scaling factor	Setting range	Default setting	Data type
6.250000000000E-002	0 ... 900 V	0 V	INT16

Subindex 0x0D: **voltage ripple max**			
Adjustable threshold for monitoring with regard to high superimposed AC voltage in the DC bus • If the threshold set here is reached, the error bit 2 is set in the MC status word 2. • If the setting is "0", monitoring is deactivated.			
Scaling factor	Setting range	Default setting	Data type
6.250000000000E-002	0 ... 400 V	0 V	INT16

0x2810 | 0x3010 - Power Module A/B

Sub.	Name	Default setting	Data type
▸ 0x09	clamping timeout	1.024 s	UNSIGNED16
▸ 0x0B	clamping factor	0.780029	UNSIGNED16
▸ 0x0C	clamping config	0x0A	UNSIGNED16

Subindex 0x09: clamping timeout

Timeout time for clamping
- During the start, especially in V/f operation, the motor current can be very high and cause an overcurrent interruption. In order to prevent this, "Clamping" is carried out: If the output current reaches the value “switch-off threshold x clamping factor”, the hardware monitoring sets the CLAMP pin, which switches off the PWM signals. In the next PWM cycle, the software automatically switches the PWM signals on again. This causes a reduced power-on time at the same frequency which corresponds to an operation at the current limit.
- Only if clamping is active longer than the time set here, the power section is switched off.

Scaling factor	Setting range	Default setting	Data type
1.0240000000000E-003	0 ... 3.072 s	1.024 s	UNSIGNED16

Subindex 0x0B: clamping factor

As of version EMDAGxxxxxxx1x

Scaling factor	Setting range	Default setting	Data type
3.051757812500E-005	0 ... 1	0.780029	UNSIGNED16

Subindex 0x0C: clamping config

Select the control mode in which clamping should be active:
Bit 0: --- (reserved)
Bit 1: activate clamping for SLVFCI
Bit 2: activate clamping for VFCI
Bit 3: activate clamping for SLVCI
Bit 4: activate clamping for VCI
Bit 5: activate clamping for SLVCS
Bit 6: activate clamping for VCS
Bit 7: activate clamping for AFC
Bit 8 ... Bit 15: --- (reserved)

Scaling factor	Setting range	Default setting	Data type
1	0x0 ... 0x007F	0x0A	UNSIGNED16

0x2900 | 0x3100 - Inverter A/B supervision

Sub.	Name	Default setting	Data type
▸ 0x09	communication fault reaction	4	UNSIGNED16
▸ 0x0C	nonfatal fault reaction	5	UNSIGNED16

Subindex 0x09: **communication fault reaction**			
Response to communication errors: 0 = no error response 1 = Warning 2 = quick stop (along the quick stop speed ramp) 3 = --- (reserved) 4 = normal stop (along the normal stop speed ramp) 5 = coasting to standstill / error			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 5	4	UNSIGNED16

Subindex 0x0C: **nonfatal fault reaction**			
Response to non-critical error: 0 = no error response 1 = Warning 2 = quick stop (along the quick stop speed ramp) 3 = --- (reserved) 4 = normal stop (along the normal stop speed ramp) 5 = coasting to standstill / error			
Scaling factor	Setting range	Default setting	Data type
1	1 ... 5 (as of firmware R6.4) 2 ... 5	5	UNSIGNED16

"nonfatal fault reaction" is executed for faults that have non-fatal effects. When a fault is pending, the inverter can either continue to operate for a limited time (reached by minimum value with quick stop ramp of 10 rpm/s) or continue to operate normally (warning).

Non-fatal faults	
DCU	**PSU**
motor tempsensor error motor overtemperature motor i2xt error ambient tempsensor error (function available up to firmware R6.3) ambient overtemperature (function available up to firmware R6.3)	–

0x2901 | 0x3101 - Inverter A/B

Sub.	Name	Default setting	Data type
▸ 0x01	itc config	0x00DF	UNSIGNED16
▸ 0x02	option config	0x0000	UNSIGNED16
▸ 0x03	warning temperature	95 °C	INT16
▸ 0x07	switching frequency	1	UNSIGNED16
▸ 0x12	ixt limitation threshold	0	INT32
▸ 0x14	ixt warning threshold	0	INT32
▸ 0x16	limitation temperature	0 °C	INT16

Subindex 0x01: **itc config**			
Configuration for inverter test (bit value 1 = execute test): Bit 0: Initialisation of time stamp Bit 1: Calibration of current offset for U/V/W phases Bit 2: Check for valid DC-bus voltage Bit 3: Loading of the bootstrap capacitor Bit 4: Calibration of resolver phase and offset Bit 5: Calibration of resolver amplitude Bit 6: Motor connection test (danger of damage to device if deactivated) Bit 7: motor earth fault detection test (danger of damage to device if deactivated) Bit 15: reserved			
Scaling factor	Setting range	Default setting	Data type
1	0x0000 ... 0x00FF	0x00DF	UNSIGNED16

Subindex 0x02: **Option config**			
MOBILE DCU Configuration (bit value 0 = no, 1 = yes): Bit 0: Trigger error if another inverter reports an error. Bit 1 ... 2: Control of other inverter: • 0: Use separate inverter output • 1: Use the outputs of the velocity controller and DC link controller of the other inverter (2 x 3-phase control) • 2: Use the outputs of the modulator of the other inverter (6-phase control) • 3: Reserved Bit 3: Invert the switching direction of the inverter's pulse width modulation signals Bit 4: motor earth fault detection test (danger of damage to device if deactivated) Bit 15: reserved MOBILE DCU PSU Configuration (bit value 0 = no, 1 = yes): Bit 0: Trigger error if another inverter reports an error. Bit 1: motor earth fault detection test (danger of damage to device if deactivated) Bit 2: reserved Bit 3: Invert the switching direction of the inverter's pulse width modulation signals Bit 4: motor earth fault detection test (danger of damage to device if deactivated) Bit 15: reserved MOBILE DCU S Configuration (bit value 0 = no, 1 = yes): Bit 0: motor earth fault detection test (danger of damage to device if deactivated) Bit 2: reserved Bit 3: Invert the switching direction of the inverter's pulse width modulation signals Bit 4: motor earth fault detection test (danger of damage to device if deactivated) Bit 15: reserved			
Scaling factor	Setting range	Default setting	Data type
1	0x0000 ... 0x000F	0x0000	UNSIGNED16

Subindex 0x03: **Warning temperature**			
Warning threshold for temperature monitoring of the power section • If the threshold set here is reached, the warning bit 5 is set in the MC status word 1. • The warning threshold has a hysteresis of 5 °C.			
Scaling factor	Setting range	Default setting	Data type
6.250000000000E-002	0 ... 150 °C	95 °C	INT16

Subindex 0x07: **Switching frequency**			
Switching frequency of the inverter: 0 = 16 kHz, auto ("auto" = Adaptation of the switching frequency as a function of current and stator frequency) 1 = 8 kHz, auto 2 = 4 kHz, auto 3 = 16 kHz, permanent 4 = 8 kHz, permanent 5 = 4 kHz, permanent 6 = 2 kHz, permanent 7 = 16 kHz, fixed, VAC (for the “Power socket” application - with a higher continuous current but lower overload capacity)			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 7	1	UNSIGNED16

Subindex 0x12: **ixt limitation threshold**			
Threshold to limit the ixt-utilisation of the power section • The output current is reduced to 0 as of the threshold up to the maximum value. • Limitation is deactivated if the value is 0.			
Scaling factor	Setting range	Default setting	Data type
2.980232238770E-008	0 ... 1.964999	0	INT32

Subindex 0x14: **ixt warning threshold**			
Warning threshold for ixt-utilisation of the power section. • Warning is deactivated if the value is 0.			
Scaling factor	Setting range	Default setting	Data type
1.862645149231E-009	0 ... 2.000000	0	INT32

Subindex 0x16: **limitation temperature**			
Limitation of the power section’s temperature • The output current is reduced to 0 as of the threshold up to the maximum value. • Limitation is deactivated if the value is 0.			
Scaling factor	Setting range	Default setting	Data type
6.250000000000E-002	0 ... 150 °C	0 °C	INT16

6.3 Precharge function

The MOBILE Inverter has a precharge function to precharge the internal DC-bus capacitors. The precharge function is used if there is no external precharge function (e.g. BMS - battery management system).

Conditions

- The cover sensor is clean and free from dust and dirt.
  - Depending on the device's site of installation and the possible soiling, the cover sensor must be cleaned regularly to ensure trouble-free operation.
- The device's cover is mounted correctly.
- Monitoring for open MOBILE cover is activated.
- The control connections (KL15, KL30, KL31, CAN, etc.) are wired correctly.
- No error is pending.

Note!

The MOBILE DCU and PSU devices have an intelligent HV InterLock functionality. This triggers if the previously mentioned requirements are not met.

- For more information on HV InterLock functionality, refer to the device manual.
- The HV InterLock functionality is not available on the MOBILE DCU S.

Required parameter settings

Setpoint for precharging the DC link by means of a 2-point controller For this Precharge function to be activated, the following two parameters must be configured correctly and the settings must be saved in the parameter set:

1. Parameter 0x2730:0x05 - "Plug Cover: config":
   - Set the value "1" in this parameter to enable monitoring for open MOBILE cover.
2. Parameter 0x2732:0x0A (MC) - "DC Link: voltage precharge demand":
   As of firmware R6.3: Parameter 0x4010:0x05 (APPC)
   - In this parameter, set the setpoint for precharging the DC link.
   - Precharging gets active if the DC link voltage is lower than the value set here. If the DC link voltage is already higher than the value set here, precharging will not be started.
   - For further details see the following parameter description for 0x2732:0x0A (MC).
     As of firmware R6.3: Parameter 0x4010:0x05 (APPC)

6.3.1 Precharge via Public CAN

This function is available as of firmware R6.3.

The setpoint for precharging the DC link can also be specified cyclically via Public CAN. If 0x00 orr 0xFF is received or an RxMsgTimeout is pending, the stored value is used by "voltagePrechargeDemand" 0x4010:0x05.

See chapter "Public CAN receive messages" ▸ Status of the master control

6.3.2 Precharge via FLX_INx

This function is available as of firmware R6.4.

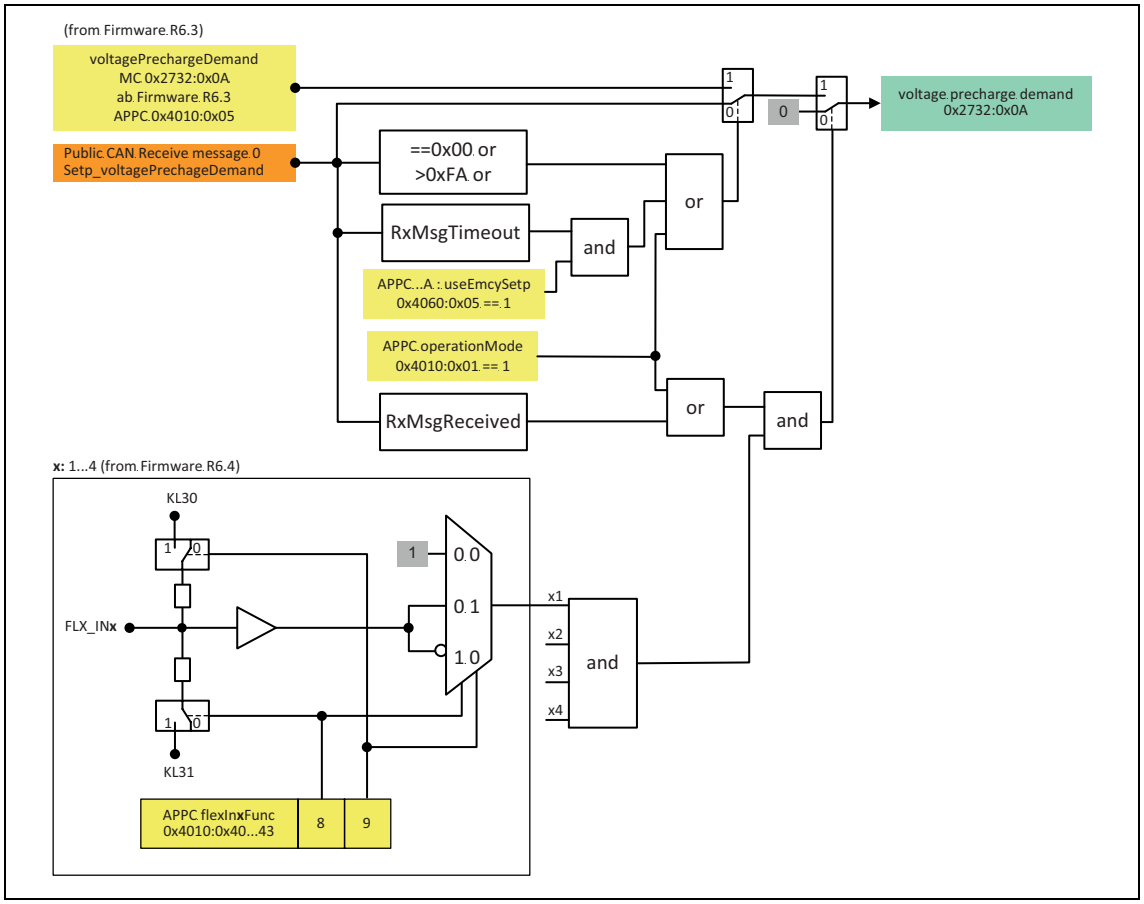
The DC link precharge is activated via digital inputs.

- The following settings for FlexIn[x]Func are used for the precharge function:
  - 8: Precharge enable, DC link (high-active)
  - 9: Precharge enable, DC link (low-active)

  See Possible settings of the inputs. (📖 50)

If several FlexIn[x]Func are configured with functions 8 or 9, the correct level must be applied to all corresponding digital inputs to activate the precharge function.

If no FlexIn[x]Func is configured for activating the precharge function, the device uses the standard setpoint 0x4010:0x05 (APPC) - "voltagePrechargeDemand" or the setpoint specified in Public CAN.
▸ Status of the master control



[6-1] Signal flow of the precharge function

0x2730 - Plug Cover

Subindex 0x05: **config**			
Monitoring of open MOBILE cover: 0 = deactivated 1 = activated **Note:** monitoring is not available for MOBILE DCU S.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 1	1	UNSIGNED16

0x2732 - DC Link

Subindex 0x0A: **voltage precharge demand**			
This function is available up to firmware R6.2. Setpoint for precharging the DC link • On devices EMDxG1xxxxxx0x and EMDxG2xxxxxx0x the setpoint can be adjusted to max. 300 V. • Setpoint for precharging the DC link by means of a 2-point controller Precharging starts when terminal 15 is switched on if the DC link voltage is less than the value set here. If the DC link voltage is already higher than the value set here, precharging will not started. • Switch-on threshold of the 2-point controller = set setpoint - 5 V. • Switch-off threshold of the 2-point controller = set setpoint + 5 V. • The setting "0" deactivates the precharge of the DC bus. **Note:** The cover must be closed and monitoring by the cover sensor must be activated.			
Scaling factor	Setting range	Default setting	Data type
6.250000000000E-002	0 ... 850 V	0 V	INT16

0x4010 - APPC device

Subindex 0x05: **voltagePrechargeDemand**			
This function is available as of firmware R6.3. Setpoint for precharging the DC link • On devices EMDxG1xxxxxx0x and EMDxG2xxxxxx0x the setpoint can be adjusted to max. 300 V. • Setpoint for precharging the DC link by means of a 2-point controller Precharging starts when terminal 15 is switched on if the DC link voltage is less than the value set here. If the DC link voltage is already higher than the value set here, precharging will not started. • Switch-on threshold of the 2-point controller = set setpoint - 5 V. • Switch-off threshold of the 2-point controller = set setpoint + 5 V. • The setting "0" deactivates the precharge of the DC bus. **Note:** The cover must be closed and monitoring by the cover sensor must be activated.			
Scaling factor	Setting range	Default setting	Data type
6.250000000000E-002	0 ... 850 V	0 V	INT16

Start precharge

Once all preconditions have been met, precharging starts when the MOBILE device is switched on.

Precharge procedure:

1. Switch on MOBILE device (terminal 15).
2. The DC link voltage is run up until the configured precharge value has been reached.
   - The status is indicated by the LED on the MOBILE device and in the CAN message. See chapter "Public CAN transmit messages" ▸ Device status of the MOBILE (📖 179)
3. The main contactor of the HV-DC battery can be closed.

Note!

It is not an issue if the precharge voltage is slightly higher than the DC-bus voltage.

Example of precharge for DCU V010:

Precharging of the 240 µF to 800 V takes approx. 8 s

➞ Energy content is E = 1/2 * C * U^2 = 76.8 J

➞ Power of the precharge power supply unit is approx. 9.6 W

After 20 s the precharge power supply unit protects itself against overheating and goes into a pulse mode (1 s precharge, 250 ms cool down).

Precharge status

Yellow LED on device:

LED	Device status	Comments
○	DC bus loaded	V_{DC} > 50 V
◎	Precharge active	Blinking slowly
◎	Cover not closed	Blinking fast (Precondition: monitoring for opened MOBILE cover is activated in 0x2730:0x05)

○ LED off

◎ LED blinking every 0.4 s

◎ LED blinking every 0.2 s

If "dc link voltage min" and "precharge demand" are lower than the current DC link voltage when the device is switched on, the status bit "Precharged" is initialized directly to 1.

Additional function available as of firmware R6.4:

The status bit "Precharged" is set to 1 when "voltagePrechargeDemand" is > 0 V and the DC link voltage is higher than "voltagePrechargeDemand".

The status bit "Precharged" is reset to 0 when "voltagePrechargeDemand" is changed and the new value is lower than the current DC link voltage plus 10 V (hysteresis).

CAN-ID 0x18FF00yy: Device status of the MOBILE (📖 179)

6.4 Discharge function

This function is available as of firmware R6.4.

To achieve significantly faster discharge times, the DC link can be discharged with connected loads. Discharging to a DC link voltage of 0 V is only possible with motors. With the PSU, active discharge is only possible to a lower voltage limit (see device manual). Below that value, only switching losses contribute to the discharge process.

Changes compared to normal mode in the event of a DC link discharge command

- If a precharge function is active, it is interrupted.
- The precharged status is set to 0.
- The lower limit of the DC link controller is set to 0 V.
- Dropping below the minimum DC link voltage does not cause a fault.
- Dropping below the minimum output voltage does not cause a fault (PSU).

This means the loads can continue to operate until the DC link voltage has dropped to the desired discharge voltage. To correctly complete the discharge process, the DCU or PSU must first be switched off before the discharge command can be deactivated.

Options for activating the discharge function

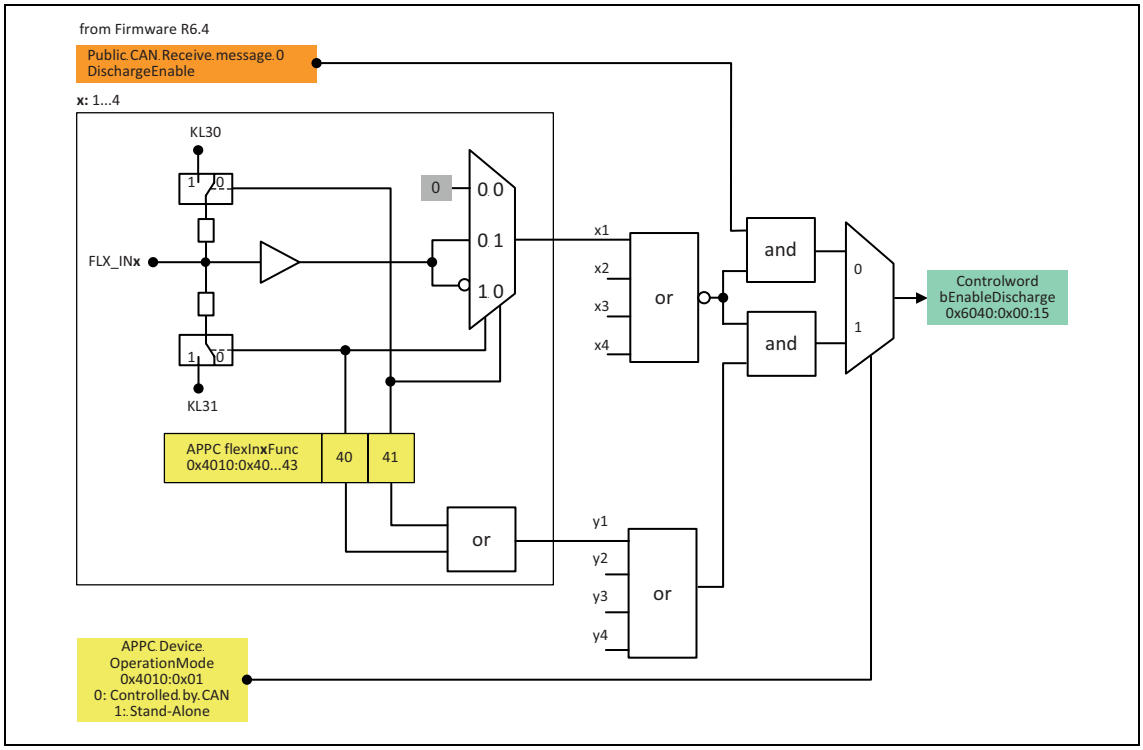
1. The signal "DischargeEnable" (Status of the master control) is received via Public CAN.
2. The following settings for FlexIn[x]Func are used for the discharge function:
   - 40: Discharge enable DC link (high-active) (if all FlexInxFunc != 40, 41 and Stand-Alone: Discharge is deactivated)
   - 41: Discharge enable DC link (low-active) (if all FlexInxFunc != 40, 41 and Stand-Alone: Discharge is deactivated)

   See Possible settings of the inputs. (📖 50)

For all FlexIn[x]Func configured with functions 40 or 41, the correct level must be applied to the corresponding inputs so that the signal "DischargeEnable" is transmitted by Public CAN to Private CAN. Otherwise the bit "bEnableDischarge" is set to 0.

If OperationMode = 1 (stand-alone operation) and if no FlexIn[x]Func is set to function 40 or 41, the bit "bEnableDischarge" is set to 0.

The signals received on Private CAN "bPrecharged" and "bDischarged" are transmitted via Public CAN in the message "DcLinkChargeState". ▸ Device status of the MOBILE (📖 179)



Signal flow of the discharge function

6.5 Motor/motor feedback

Objects described in this chapter and their availability for the MOBILE devices:

Object	Name	MOBILE			
		DCU	PSU	DCU PSU	DCU S
0x2910	Motor INV A	●			●
0x3110	Motor INV B	●		●	
0x2820	Motor Feedback Plug INV A	●			●[1)]
0x3020	Motor Feedback Plug INV B	●		●	
0x2822	Resolver INV A	●			
0x3022	Resolver INV B	●		●	

[1)] The temperature sensor is connected to X1

6.5.1 Motor parameters

0x2910 | 0x3110 - Motor A/B

Sub.	Name	Default setting	Data type
▸ 0x01	control mode	0x0001	UNSIGNED16
▸ 0x02	pole pairs	1	UNSIGNED16
▸ 0x03	temperature warning limit	75 °C	INT16
▸ 0x04	temperature error limit	85 °C	INT16
▸ 0x06	stator frequency error limit	500 Hz	INT32
▸ 0x07	feedback config	0x0000	UNSIGNED16
▸ 0x08	direction	0	UNSIGNED16
▸ 0x09	temperature limitation limit	0 °C	INT16
▸ 0x13	stall detection cos phi min	0	INT16
▸ 0x14	stall detection current min	2 A	REAL32

Subindex 0x01: **Control mode**			
Bit coded setting of the control mode for open-loop/closed-loop motor control ▸ Setting the control mode			
Scaling factor	Setting range	Default setting	Data type
1	0x0001 ... 0xFFFF	0x0001	UNSIGNED16

Subindex 0x02: **Pole pairs**			
Number of motor pole pairs			
Scaling factor	Setting range	Default setting	Data type
1	1 ... 100	1	UNSIGNED16

Subindex 0x03: **Temperature warning limit**			
Warning threshold for temperature monitoring of the motor • If the threshold set here is reached, the warning bit 15 is set in the MC status word 1. • The warning threshold has a hysteresis of 5 °C.			
Scaling factor	Setting range	Default setting	Data type
6.250000000000E-002	0 ... 350 °C	75 °C	INT16

Subindex 0x04: **Temperature error limit**			
Error threshold for temperature monitoring of the motor • If the threshold set here is reached, the error bit 16 is set in the MC status word 1. • The error threshold has a hysteresis of 5 °C.			
Scaling factor	Setting range	Default setting	Data type
6.250000000000E-002	0 ... 350 °C	85 °C	INT16

Subindex 0x06: **Stator frequency error limit**			
Error threshold for monitoring the motor stator frequency • If the threshold set here is reached, the error bit 17 is set in the MC status word 1. • The upper limit value depends on the device version (in the case of standard devices = 599 Hz).			
Scaling factor	Setting range	Default setting	Data type
2.441406250000E-004	0 ... 2000 Hz	500 Hz	INT32

Subindex 0x07: **Feedback config**			
Bit coded configuration of the position and temperature feedback ▸ Configuring position and temperature feedback			
Scaling factor	Setting range	Default setting	Data type
1	0x0000 ... 0x0FFF	0x0000	UNSIGNED16

Subindex 0x08: **Direction**			
Direction of rotation of the motor: 0 = not inverted 1 = inverted			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 1	0	UNSIGNED16

Subindex 0x09: **temperature limitation limit**			
Threshold for motor temperature limitation • The output current is reduced to 0 as of the threshold up to the maximum value. • Limitation is deactivated if the value is 0.			
Scaling factor	Setting range	Default setting	Data type
6.250000000000E-002	0 ... 350 °C	0 °C	INT16

Subindex 0x13: **stall detection cos phi min**			
Minimum power factor for standstill detection • Function is deactivated if the value is 0.			
Scaling factor	Setting range	Default setting	Data type
6.103515625000E-005	0 ... 1	0	INT16

Scaling factor	Setting range	Default setting	Data type
1	0 ... 350 A	2 A	REAL32

6.5.2 Position encoder and temperature sensor

The position and temperature feedback are configured via the "feedback config" parameter.

Note!

The position and temperature feedback can only be configured if the inverter is in the "Not ready to switch on" or "Switch on disabled" state (inverter is not switched on).

- The inverter is in the “Switch on disabled” state after the device restart until the controller is enabled for the first time.

0x2820 | 0x3020 - Motor Feedback Plug A/B

Sub.	Name	Default setting	Data type
▸ 0x04	temperature sensor type	0	UNSIGNED16
▸ 0x05	position device type	0	UNSIGNED16

Subindex 0x04: **temperature sensor type**			
0 = no thermal sensor connected 1 = KTY83-110 2 = KTY84-130 3 = PT1000 4 = a thermal NC contact according to DIN 44080 or up to three PTC thermistors according to DIN 44081 in series connection			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 4	0	UNSIGNED16

Subindex 0x05: **position device type**			
0 = no position encoder connected 1 = resolver 2 = --- (reserved) 3 = --- (reserved)			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 3	0	UNSIGNED16

feedback config			
INV A	INV B	Bit	Info
0x2910:0x07	0x3110:0x07	0 ... 3	Encoder mounting direction:
		0	Mounting direction not inverted
		1	Mounting direction inverted
		2 ... 15	Mounting direction not inverted
		4 ... 7	Position to be used:
		0	Use normal position
		1	Use position of the encoder of the other inverter
		2	Use no position
		3 ... 15	Use normal position
		8 ... 11	Temperature to be used:
		0	Use normal temperature
		1	Use temperature of the motor temperature encoder of the other inverter
		2	Use no temperature
		3 ... 15	Use normal temperature
		12 ... 15	Reserved

6.5.3 Resolver

0x2822 | 0x3022 - Resolver A/B

Sub.	Name	Default setting	Data type
▸ 0x03	position offset	0 rad	INT16
▸ 0x05	pole pairs ratio	1	UNSIGNED16
▸ 0x12	frequency filter factor	0.019996	INT32
▸ 0x13	dynamic offset factor	5	INT16

Subindex 0x03: **position offset**			
Electric motor angular offset for correcting the electric motor position			
Scaling factor	Setting range	Default setting	Data type
9.587379920000E-005	-3.141592 ... 3.141496 rad	0 rad	INT16

Subindex 0x05: **pole pairs ratio**			
Ratio of number of pole pairs - motor/resolver • Here , set the number of motor pole pairs divided by the number of resolver pole pairs.			
Scaling factor	Setting range	Default setting	Data type
1	1 ... 32	1	UNSIGNED16

Subindex 0x12: **frequency filter factor**			
IIR filter first-order: Factor = Ts / τ • where Ts = 128 µs			
Scaling factor	Setting range	Default setting	Data type
7.629394531250E-006	0 ... 0.5	0.019996	INT32

Subindex 0x13: **dynamic offset factor**			
Speed-dependent angle correction for compensating the filer of the sine and cosine signals • Setting "5" corresponds to 5 * 128 µs = 640 µs • This parameter serves to compensate additional speed-dependent angle errors (e.g. caused by the resolver).			
Scaling factor	Setting range	Default setting	Data type
3.125000000000E-002	0 ... 10	5	INT16

6.5.4 Motor temperature monitoring

The following parameters have to be set for monitoring the motor temperature:

Parameter			
INV A	INV B	Name	Info
0x2820:0x04	0x3020:0x04	temperature sensor type	Temperature sensor used
0x2910:0x03	0x3110:0x03	temperature warning limit	Warning threshold for temperature monitoring
0x2910:0x04	0x3110:0x04	temperature error limit	Error threshold for temperature monitoring
0x2910:0x07	0x3110:0x07	feedback config	Bit coded configuration of the position and temperature feedback ▸ Configuring position and temperature feedback
0x2910:0x09	0x3110:0x09	temperature limitation limit	Threshold for motor temperature limitation

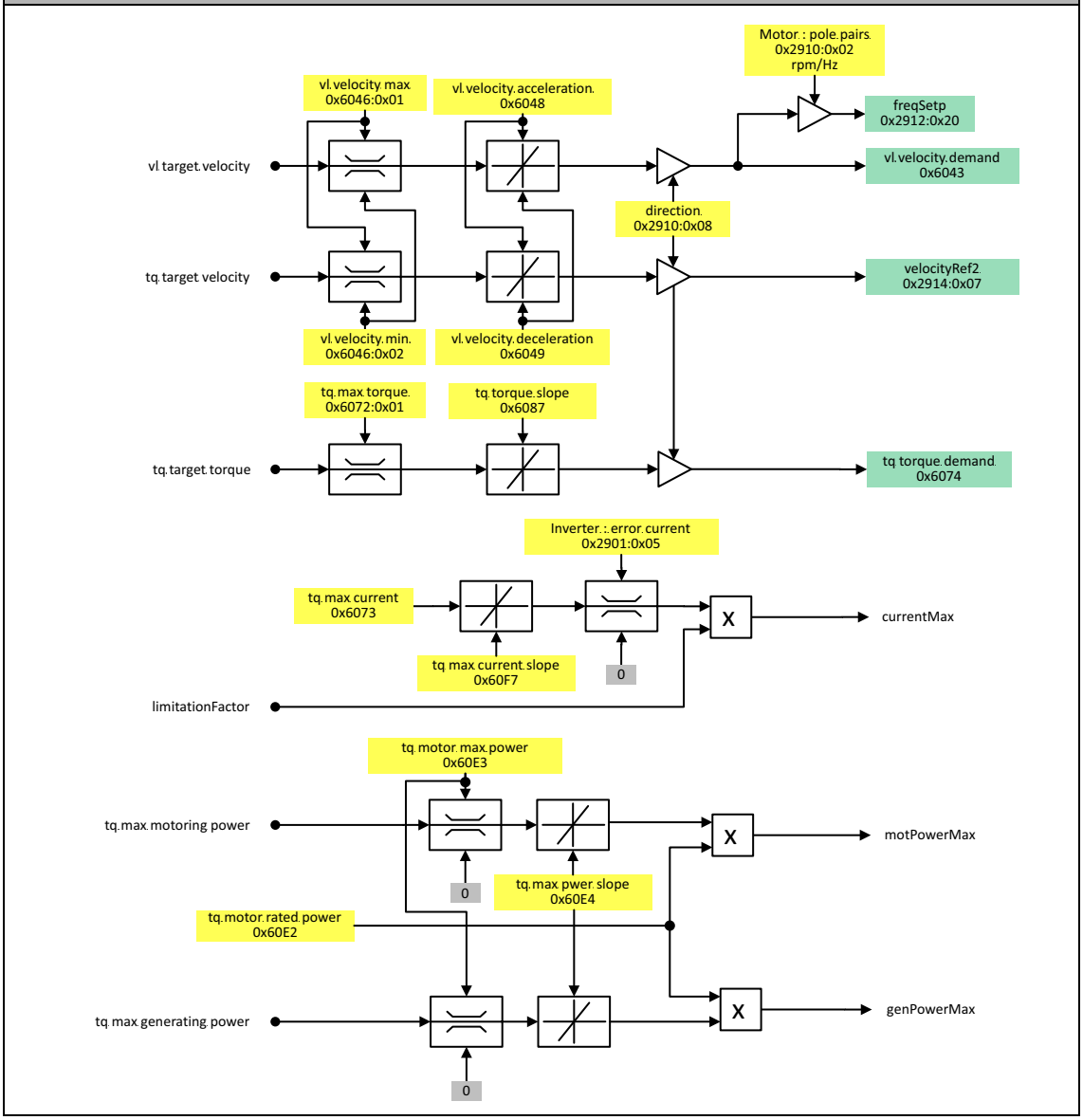
6.6 Drive Profile Generator

0x6060 | 0x6860 - Drive Profile Inverter A/B modes of operation

Selection of the operating mode:
-5 = Generator Mode
0 = no operating mode (standstill)
2 = Velocity Mode
4 = Profile Torque Mode
8 = Cyclic Synchronous Position Mode

Scaling factor	Setting range	Default setting	Data type
1	-5 ... 8	2	INT16

Signal flow



[6-2] Signal flow for Drive Profile Generator (simplified representation)

6.6.1 Velocity Mode

Objects described in this chapter and their availability for the MOBILE devices:

Object	Name	MOBILE			
		DCU	PSU	DCU PSU	DCU S
0x6046	Drive Profile Inverter vl velocity max min INV A	●			●
0x6846	Drive Profile Inverter vl velocity max min INV B	●		●	
0x6048	Drive Profile Inverter vl velocity acceleration INV A	●			●
0x6848	Drive Profile Inverter vl velocity acceleration INV B	●		●	
0x6049	Drive Profile Inverter vl velocity deceleration INV A	●			●
0x6849	Drive Profile Inverter vl velocity deceleration INV B	●		●	

This operating mode provides a fast speed follower. The *setp_Speed* speed setpoint is determined via Public CAN.

0x6046 | 0x6846 - Drive Profile Inverter A/B vl velocity max min

Sub.	Name	Default setting	Data type
▸ 0x01	Max.	3000.000000 rev/min	INT32
▸ 0x02	Min.	-3000.000000 rev/min	INT32

Subindex 0x01: **max**			
Upper speed limit			
Scaling factor	Setting range	Default setting	Data type
6.103515625000E-005	-131072 ... 131072 rev/min	3000.000000 rev/min	INT32

Subindex 0x02: **min**			
Lower speed limit			
Scaling factor	Setting range	Default setting	Data type
6.103515625000E-005	-131072 ... 131072 rev/min	-3000.000000 rev/min	INT32

0x6048 | 0x6848 - Drive Profile Inverter A/B vl velocity acceleration

Acceleration
- If the setting is "0", no acceleration ramp is active and the setpoint speed is directly followed in positive direction .

Scaling factor	Setting range	Default setting	Data type
2.500000000000E-001	0 ... 536870912 rev/(min*s)	500 rev/(min*s)	INT32

0x6049 | 0x6849 - Drive Profile Inverter A/B vl velocity deceleration

Deceleration
- If the setting is "0", no deceleration ramp is active and the setpoint speed is directly followed in negative direction.

Scaling factor	Setting range	Default setting	Data type
2.500000000000E-001	-536870912 ... 0 rev/(min*s)	-500 rev/(min*s)	INT32

6.6.2 Profile Torque Mode

Objects described in this chapter and their availability for the MOBILE devices:

Object	Name	MOBILE			
		DCU	PSU	DCU PSU	DCU S
0x6072	Drive Profile Inverter tq max torque INV A	●			●
0x6872	Drive Profile Inverter tq max torque INV B	●		●	
0x6073	Drive Profile Inverter tq max current INV A	●			●
0x6873	Drive Profile Inverter tq max current INV B	●		●	
0x6076	Drive Profile Inverter tq motor rated torque INV A	●			●
0x6876	Drive Profile Inverter tq motor rated torque INV B	●		●	
0x6085	Drive Profile Inverter quick stop deceleration INV A	●			●
0x6087	Drive Profile Inverter tq torque slope INV A	●			●
0x6887	Drive Profile Inverter tq torque slope INV B	●		●	
0x60F6	Drive Profile Inverter tq target velocity INV A	●			●
0x68F6	Drive Profile Inverter tq target velocity INV B	●		●	
0x60F7	Drive Profile Inverter tq max current slope INV A	●			●
0x68F7	Drive Profile Inverter tq max current slope INV B	●		●	

This operating mode provides a quick torque follower with speed limitation.

- The *setp_Torque* torque setpoint is determined via Public CAN.
- The *setp_Speed*speed setpoint given via Public CAN defines in this mode the upper speed limit for speed limitation. The lower speed limit can be set in 0x60F6 (or 0x68F6 for motor B).

0x6072 | 0x6872 - Drive Profile Inverter A/B tq max torque

Maximum torque
- 100 % … rated motor torque (0x6076 or 0x6876 for motor B)

Scaling factor	Setting range	Default setting	Data type
0.1	0 ... 3276.700000 %	150 %	INT16

0x6073 | 0x6873 - Drive Profile Inverter A/B tq max current

Maximum current

Scaling factor	Setting range	Default setting	Data type
1.562500000000E-002	0 ... 350 A	100 A	INT16

0x6076 | 0x6876 - Drive Profile Inverter A/B tq motor rated torque

Rated motor torque

Scaling factor	Setting range	Default setting	Data type
0.001	0.001 ... 4294967 Nm	100 Nm	UNSIGNED32

0x6085 | 0x6885 - Drive Profile Inverter A/B quick stop deceleration

Scaling factor	Setting range	Default setting	Data type
2.500000000000E-001	-536870912 ... -10 rev/(min*s)	-1000 rev/(min*s)	INT32

0x6087 | 0x6887 - Drive Profile Inverter A/B tq torque slope

Ramp for changing the torque
- In [%/s] based on the rated motor torque (0x6076 or 0x6876 for motor B)
- If the setting is "0", no ramp is active and the setpoint torque is directly followed.

Scaling factor	Setting range	Default setting	Data type
0.1	0 ... 429496730 %/s	500 %/s	UNSIGNED32

0x60F6 | 0x68F6 - Drive Profile Inverter A/B tq target velocity

Lower speed limit for speed limitation

Scaling factor	Setting range	Default setting	Data type
6.103515625000E-005	-131072 ... 131072 rev/min	0 rev/min	INT32

0x60F7 | 0x68F7 - Drive Profile Inverter A/B tq max current slope

Ramp for changing the current
- If the setting is "0", no ramp is active and the setpoint current is directly followed.

Scaling factor	Setting range	Default setting	Data type
2.500000000000E-001	0 ... 1073741824 A/s	25 A/s	UNSIGNED32

6.6.3 Generator Mode

Objects described in this chapter and their availability for the MOBILE devices:

Object	Name	MOBILE			
		DCU	PSU	DCU PSU	DCU S
	Generator Mode	●		●	●

The generator mode operates the same way as the Profile Torque Mode. Only the current limiter in the prevailing controller mode behaves differently.

In the generator mode, the correction current of the DC-bus controller is added to the torque-generating Q setpoint current. This makes a correction past 0 possible. In all other modes the DC bus controller only has a limiting function and can limit the torque-generating Q setpoint current at most down to 0.

Note!

In generator mode, monitoring for open MOBILE cover must be active. Activation takes place via the parameter 0x2730:0x05 - "Plug Cover: config".

6.6.4 Cyclic Synchronous Position Mode

Objects described in this chapter and their availability for the MOBILE devices:

Object	Name	MOBILE			
		DCU	PSU	DCU PSU	DCU S
0x607C	Drive Profile Inverter csp home offset INV A	●			
0x687C	Drive Profile Inverter csp home offset INV B	●		●	
0x60C2	Drive Profile Inverter csp interpolation time INV A	●			
0x68C2	Drive Profile Inverter csp interpolation time INV B	●		●	

This operating mode provides a fast position follower with speed and torque/feed force feedforward control. The motion profile to be processed is defined by the master control.

0x607C | 0x687C - Drive Profile Inverter A/B csp home offset

Position which is set as current position during reference search in the home position or reference setting.
- Low word: 65535 … one revolution
- High word: Number of revolutions

Scaling factor	Setting range	Default setting	Data type
9.587379920000E-005	-205887 ... 205887 rad	0 rad	INT32

0x60C2 | 0x68C2 - Drive Profile Inverter A/B csp interpolation time

Here, the cycle time for the process data communication used by the master control is to be set.
- Preset interpolation time interval = $2 * 10^{-3}$ s = 2 ms

Sub.	Name	Default setting	Data type
▸ 0x01	period value	0x00	UNSIGNED8
▸ 0x02	index	-3	INT16

Subindex 0x01: **period value**			
Basic multiplier for interpolation time interval			
Scaling factor	Setting range	Default setting	Data type
1	0x00 ... 0xFF	0x00	UNSIGNED8

Subindex 0x02: **index**			
Exponent for interpolation time period			
Scaling factor	Setting range	Default setting	Data type
1	-128 ... 63	-3	INT16

Definition of the interpolation time period
$\text{Interpolations-Zeitintervall}[s] = \text{period value} \cdot 10^{\text{index}}[s]$

6.7 Overview of the control modes

Objects described in this chapter and their availability for the MOBILE devices:

Object	Name	MOBILE			
		DCU	PSU	DCU PSU	DCU S
0x2910	Motor control mode INV A	●			●
0x3110	Motor control mode INV B	●		●	

The MOBILE supports different modes for open-loop/closed-loop motor control. The control mode is selected via the "control mode" parameter. The sensorless V/f characteristic control for asynchronous motors with linear V/f characteristic is set by default.

control mode				
INV A	INV B	Bit	Info	
0x2910:0x01	0x3110:0x01	0 ... 7	Control system	
			0	Invalid setting
			1	SLVFCI - Sensorless V/f characteristic control for asynchronous motors
			2	Reserved
			3	SLVCI - Sensorless vector control for asynchronous motors
			4	VCI - Vector control for asynchronous motors
			5	SLVCS - Sensorless vector control for synchronous motors
			6	VCS - Vector control for synchronous motors
			7 ... 255	Reserved
		8	Observation variant for positioning speed	
			0	Fundamental wave model
			1	Sliding Mode Observer
		9 ... 11	Reserved	
		12 ... 13	Settings for SLVFCI:	
			0	Linear V/f characteristic
			1	Square-law V/f characteristic
			2	Reserved
			3	Reserved
		14	Flying restart circuit	
			0	Deactivated
			1	Activated
		15	Settings for VCS:	
			0	Without decoupling of iq and id
			1	With decoupling of iq and id

6.7.1 Combinations of control mode and CiA402 operating mode

The following table shows which CiA402 operating modes can be combined with which control mode. The CiA402 operating mode is selected via the parameter "modes of operation" (object 0x6060 and 0x6860).

CiA402 operating mode (Mode of operation)	**Control system**				
	Asynchronous motor (ASM)			Synchronous motor (PSM)	
	Without encoder		with encoder	Without encoder	with encoder
	SLVFCI	SLVCI	VCI	SLVCS	VCS
Velocity Mode	●	●	●	●	●
Profile Torque Mode	-	●*	●	●*	●
Cyclic Synchronous Position Mode	-	-	●	-	●
Generator Mode	-	●	●	●	●
* not at speeds around 0 rpm					

Legend:	
SLVFCI	Sensorless V/f characteristic control for asynchronous motors
SLVCI	Sensorless vector control for asynchronous motors
VCI	Vector control for asynchronous motors
SLVCS	Sensorless vector control for synchronous motors
VCS	Vector control for synchronous motors

6.7.2 Combinations of control mode and motor

Motor	Control system				
	SLVFCI	SLVCI	VCI	SLVCS	VCS
Sensorless asynchronous motor	●	●			
Asynchronous motor with resolver	(●)		●		
Sensorless synchronous motor				●	
Synchronous motor with resolver				(●)	●
Sensorless asynchronous generator		●			
Asynchronous generator with resolver		(●)	●		
Sensorless synchronous generator				●	
Synchronous generator with resolver				(●)	●

Legend:	
SLVFCI	Sensorless V/f characteristic control for asynchronous motors
SLVCI	Sensorless vector control for asynchronous motors
VCI	Vector control for asynchronous motors
SLVCS	Sensorless vector control for synchronous motors
VCS	Vector control for synchronous motors
●	Evaluation of the motor feedback
(●)	No or limited evaluation of the motor feedback

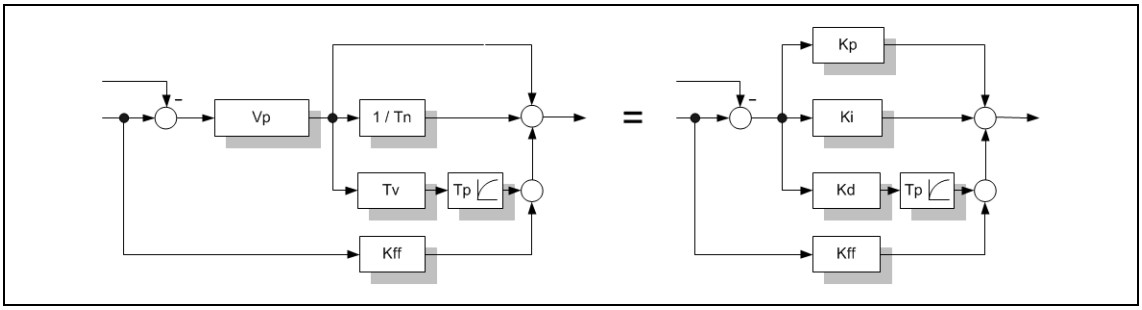
Structure of the PID controllers used

The PID controllers used can be configured with the parameters Vp (proportional gain), Tn (reset time), Tv (derivative time) and Tp (parasitic time constant). Internally the controllers work with Kp, Ki and Kd. The conversion is defined as follows:

- Kp = Vp
- Ki = Vp / Tn if Vp != 0, otherwise Ki = 1 / Tn
- Kd = Vp * Tv if Vp != 0, otherwise Kd = Tv

The feedforward control is weighted with the parameter Kff.

The parasitic time constant (Tp) is the time constant of the PT1 element which filters the D component and should be chosen as small as possible compared to the derivative time (Tv), but must not be smaller than the cycle time.



[6-3] Structure of the PID controllers used

6.8 SLVFCI - Sensorless V/f characteristic control for asynchronous motors

Objects described in this chapter and their availability for the MOBILE devices:

Object	Name	MOBILE			
		DCU	PSU	DCU PSU	DCU S
0x2912	Motor SLVFCI INV A	●			●
0x3112	Motor SLVFCI INV B	●		●	

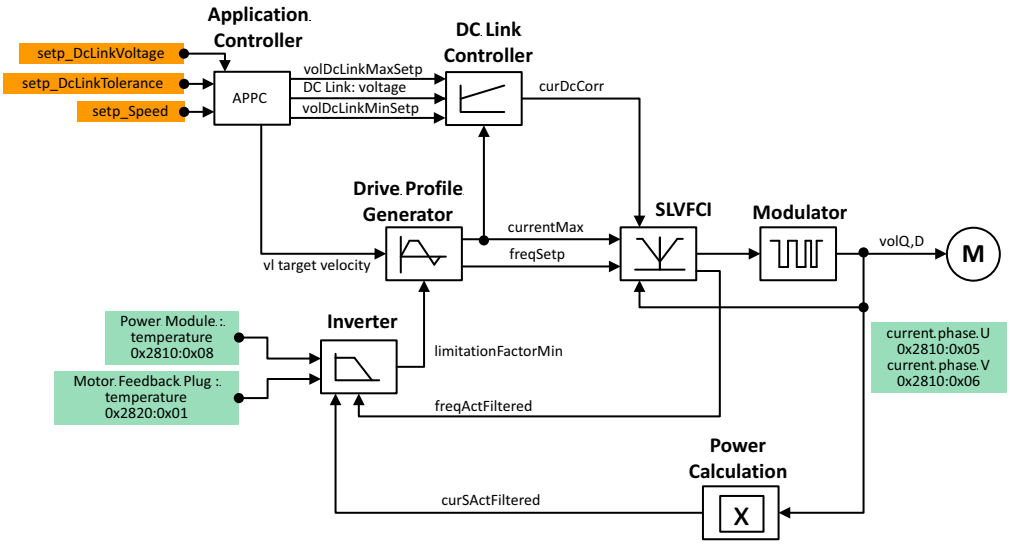
In case of the V/f characteristic control, the motor voltage of the inverter is determined by means of a linear or quadratic characteristic depending on the field frequency or motor speed to be generated. The voltage follows a preselected characteristic.

Possible CiA402 operating modes with this control mode:

CiA402 operating mode (Mode of operation)	Control system				
	SLVFCI	SLVCI	VCI	SLVCS	VCS
Velocity Mode	●	●	●	●	●
Profile Torque Mode	-	●	●	●*	●
Cyclic Synchronous Position Mode	-	-	●	-	●
Generator Mode	●	●	●	●	●

* not at speeds around 0 rpm

Signal flow



Links:
Application Controller: Application controller
DC Link Controller: DC link controller
Function SLVFCI
Inverter
Drive Profile Generator
Power Calculation: Power calculation

[6-4] Overview of signal flow for sensorless V/f characteristic control for asynchronous motors (simplified representation)

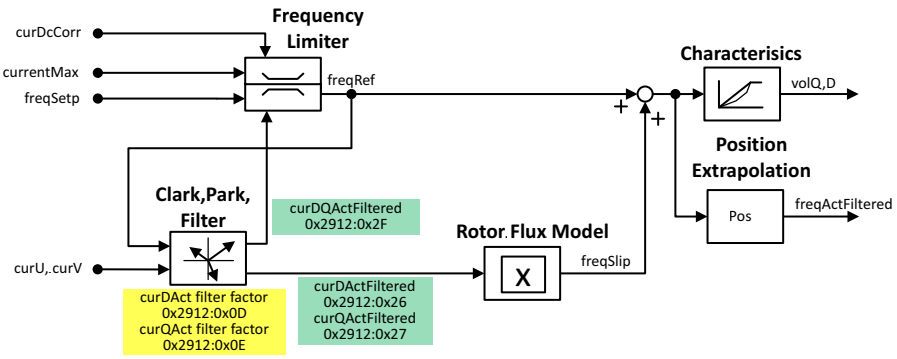
Input variables via Public CAN

Name	Info	Further information
setp_DcLinkVoltage	Setpoint for DC-bus voltage	▸ Status of the master control
setp_DcLinkTolerance	This value is added to the *setp_DcLinkVoltage* setpoint or subtracted in order to obtain the maximum and minimum value of the DC-bus voltage required for derating.	▸ Setpoints for motor A ▸ Setpoints for motor B
setp_Speed	Speed setpoint	

6.8.1 Function SLVFCI

The frequency is limited in the SLVFCI function block and the monitored slip is added. The voltages volQ and volD are generated from this frequency via the V/f characteristic.

Signal flow



Links: Frequency limiter | Rotor flow model | Characteristics | Position extrapolation

[6-5] Signal flow for function block SLVFCI (simplified representation)

Description of the parameters

0x2912 | 0x3112 - Motor A/B SLVFCI

Sub.	Name	Default setting	Data type
▸ 0x0D	curDAct filter factor	0.00128	REAL32
▸ 0x0E	curQAct filter factor	0.00128	REAL32

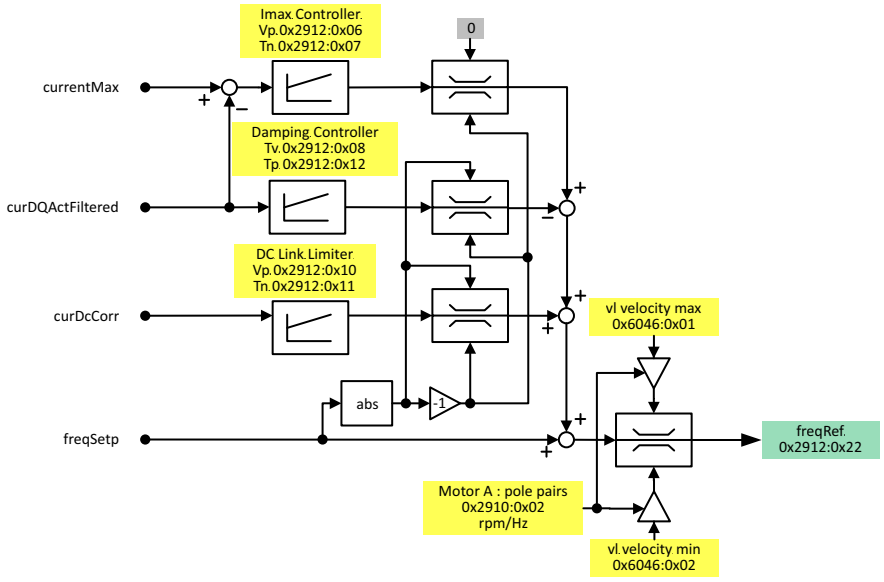
Subindex 0x0D: **curDAct filter factor**			
Factor for actual current value filter (d component) = Ts / τ (with Ts = 128 µs)			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 1	0.00128	REAL32

Subindex 0x0E: **curQAct filter factor**			
Factor for actual current value filter (q component) = Ts / τ (with Ts = 128 µs)			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 1	0.00128	REAL32

6.8.2 Frequency limiter

The frequency limiter is used to increase or limit the motor frequency by means of the current DC link voltage and the current stator current. It is implemented with the function blocks IMax Controller, Damping Controller and DC Link Limiter.

Signal flow



[6-6] Signal flow for frequency limiter (simplified representation)

Imax Controller

The Imax Controller reduces the torque if the motor current reaches the current limit. With asynchronous motors, this limitation affects the setpoint frequency. The Imax Controller is realised as a PI controller with reset windup. The current limit (maximum overload current of the device) must be set in the Drive Profile parameter "tqMaxCurrent" (object 0x6073 or 0x6873).

Damping Controller

The damping controller tries to dampen any oscillations in the stator current by adapting the setpoint frequency. It is realised as a D controller.

DC Link Limiter

The DC Link Limiter adapts the setpoint frequency by means of the current correction current of the DC link controller so that the DC-bus voltage remains in the given band. It is designed as PI controller with reset windup.

Frequency limitation

The setpoint frequency changed by IMax Controller, Damping Controller and DC Link Limiter is limited to the maximum and minimum setpoint frequency which results from the speed limit values "vl velocity max" and "vl velocity min" and the number of pole pairs.

Description of the parameters

0x2910 | 0x3110 - Motor A/B

Sub.	Name	Default setting	Data type
▸ 0x02	pole pairs	1	UNSIGNED16

Subindex 0x02: **Pole pairs**			
Number of motor pole pairs			
Scaling factor	Setting range	Default setting	Data type
1	1 ... 100	1	UNSIGNED16

0x2912 | 0x3112 - Motor A/B SLVFCI

Sub.	Name	Default setting	Data type
▸ 0x06	IMax Controller Vp	0.25 Hz/A	REAL32
▸ 0x07	IMax Controller Tn	0.065 s	REAL32
▸ 0x08	Damping Controller Tv	0 s	REAL32
▸ 0x10	DC Link Limiter Vp	1 Hz/A	REAL32
▸ 0x11	DC Link Limiter Tn	0.1 s	REAL32
▸ 0x12	Damping Controller Tp	0.001 s	REAL32

Subindex 0x06: **IMax Controller Vp**			
IMax Controller: Gain Vp • The controller is designed as a PI controller.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 1000 Hz/A	0.25 Hz/A	REAL32

Subindex 0x07: **IMax Controller Tn**			
IMax Controller: Reset time Tn • The controller is designed as a PI controller.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 100 s	0.065 s	REAL32

Subindex 0x08: **Damping Controller Tv**			
Damping Controller: rate time Tv			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 100 s	0 s	REAL32

Subindex 0x10: **DC Link Limiter Vp**			
DC Link Limiter: Gain Vp • The controller is designed as a PI controller with reset windup.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 100 Hz/A	1 Hz/A	REAL32

Subindex 0x11: **DC Link Limiter Tn**			
DC Link Limiter: Reset time Tn • The controller is designed as a PI controller with reset windup.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 100 s	0.1 s	REAL32

Subindex 0x12: **Damping Controller Tp**			
Scaling factor	Setting range	Default setting	Data type
1	0.000128 ... 10 s	0.001 s	REAL32

0x6046 | 0x6846 - Drive Profile Inverter A/B vl velocity max min

Sub.	Name	Default setting	Data type
▸ 0x01	Max.	3000.000000 rev/min	INT32
▸ 0x02	Min.	-3000.000000 rev/min	INT32

Subindex 0x01: **max**			
Upper speed limit			
Scaling factor	Setting range	Default setting	Data type
6.103515625000E-005	-131072 ... 131072 rev/min	3000.000000 rev/min	INT32

Subindex 0x02: **min**			
Lower speed limit			
Scaling factor	Setting range	Default setting	Data type
6.103515625000E-005	-131072 ... 131072 rev/min	-3000.000000 rev/min	INT32

0x6073 | 0x6873 - Drive Profile Inverter A/B tq max current

Maximum current

Scaling factor	Setting range	Default setting	Data type
1.562500000000E-002	0 ... 350 A	100 A	INT16

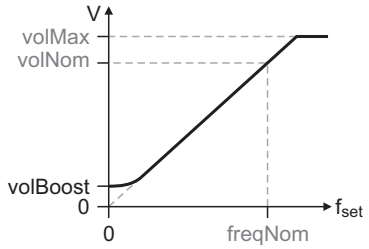
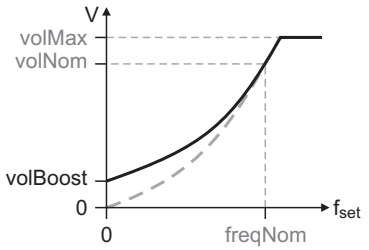
6.8.3 Characteristics

For the adaptation to the different load profiles, you can select the shape of the V/f characteristic. The selection is made via bit 12 and bit 13 of the "control mode" parameter (object 0x2910:0x01 bzw. 0x3110:0x01 for DCU B). ▸ Overview of the control modes

- **Quadratic V/f characteristic:** For drives with a load torque which is linear or quadratic in relation to speed.
- **Linear V/f characteristic:** For drives with a load torque which is constant in relation to speed. Quadratic V/f characteristics are preferred in the case of centrifugal pumps and fan drives.

Note!

- Please always check whether the corresponding drive is suitable for operation with a quadratic V/f characteristic!
- The voltages have to be entered as peaks related to the star point! (do not enter phase-to-phase voltage!)

Linear V/f characteristic	Square-law V/f characteristic
	

Parameter			
INV A	INV B	Name	Info
0x2912:0x04	0x3112:0x04	volMax	Maximally provided output voltage.
0x2912:0x02	0x3112:0x02	volNom	Nominal motor voltage
0x2912:0x01	0x3112:0x01	freqNom	Nominal motor frequency
0x2912:0x03	0x3112:0x03	volBoost	Voltage boost at lower frequencies in order that the electric resistance will be compensated at start-up.

6.8.3.1 Voltage boost

A constant, load-independent voltage boost can be specified for low speeds (below the V/f rated frequency) or for a motor standstill in order to optimise the starting performance.

Stop!

If the motor is operated at standstill for a longer time - especially in case of smaller motors - the motor can be destroyed by overtemperature!

- Connect the thermal contact (NC contact) or thermal sensor (KTY, PT1000) of the motor and configure the motor temperature monitoring.
- Operate self-ventilated motors with a blower, if required.

Depending on the required starting torque, the voltage boost must be set so that the required motor current will be available after controller enable.

- The voltage boost can be calculated by multiplying the stator resistance by the rated magnetising current:

$$U_{Boost} = R_S \cdot I_{mN}$$

- Optionally, the voltage boost can be determined empirically by increasing the setting until the rated magnetising current flows.
- The voltage boost is added to the characteristic voltage using the following formula:

$$U = \sqrt{U_{Kennlinie}^2 + U_{Boost}^2}$$

6.8.3.2 Example for setting the V/f parameter of an asynchronous motor

Sample data on the motor nameplate

kW	V	Hz	A	rpm	cos φ
2.2	Y/Δ400/230	50	4.7 / 8.1	1440	0.80

At 50 Hz the motor has a speed of 1440 rpm and therefore the following number of pole pairs:

$$\text{Polpaarzahl} = \frac{50\ \text{Hz}}{1440\ \text{min}^{-1}} \cdot 60\ \text{s} = 2.08\ (2\ \text{Polpaare})$$

Parameter settings for the V/f characteristic

Note!

The voltages have to be entered as peaks related to the star point!
(do not enter phase-to-phase voltage!)

Settings for star connection:

Parameter	setting	Calculation
volMax	327 V	$\text{volMax} = 400\ \text{V} \cdot \frac{\sqrt{2}}{\sqrt{3}} = 327\ \text{V}$
volNom	327 V	$\text{volNom} = 400\ \text{V} \cdot \frac{\sqrt{2}}{\sqrt{3}} = 327\ \text{V}$
freqNom	50 Hz	
volBoost	5 V	**Note:** When setting this parameter, make sure that the rated current at standstill will not be exceeded!

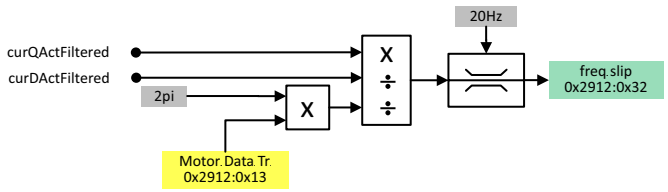
Settings for delta connection:

Parameter	setting	Calculation
volMax	187 V	$\text{volMax} = 230\ \text{V} \cdot \frac{\sqrt{2}}{\sqrt{3}} = 187\ \text{V}$
volNom	187 V	$\text{volNom} = 230\ \text{V} \cdot \frac{\sqrt{2}}{\sqrt{3}} = 187\ \text{V}$
freqNom	50 Hz	
volBoost	5 V	**Note:** When setting this parameter, make sure that the rated current at standstill will not be exceeded!

6.8.4 Rotor flow model

The monitored slip is calculated from the measured currents and the motor's moment of inertia.

Signal flow



[6-7] Signal flow rotor flow model (simplified representation)

Description of the parameters

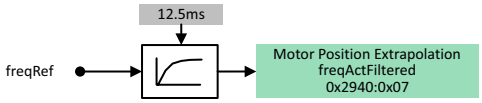
0x2912 | 0x3112 - Motor A/B SLVFCI

Subindex 0x13: **Motor Data Tr**			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 5 s	0 s	REAL32

6.8.5 Position extrapolation

The frequency is filtered with a time constant of 12.5 ms.

Signal flow



[6-8] Signal flow for position extrapolation (simplified representation)

6.9 SLVCI - Sensorless vector control for asynchronous motors

Objects described in this chapter and their availability for the MOBILE devices:

Object	Name	MOBILE			
		DCU	PSU	DCU PSU	DCU S
0x2916	Motor SLVCI INV A	●			●
0x3116	Motor SLVCI INV B	●		●	

Sensorless (field-oriented) vector control for asynchronous motors is based on a decoupled, separate control for the torque-generating and the field-generating current component. In addition, the actual speed is reconstructed by means of a motor model so that a speed sensor is not required.

In comparison to the V/f characteristic control without feedback, the following can be achieved by means of sensorless vector control

- A higher maximum torque throughout the entire speed range
- A higher speed accuracy
- A higher concentricity factor
- A higher level of efficiency
- The implementation of torque-actuated operation with speed limitation
- The limitation of the maximum torque in motor and generator mode for speed-actuated operation

Note!

The SLVCI control mode is unsuitable for applications with
- low negative speeds and positive torque,
- low positive speeds and negative torque.

Recommended alternative control mode:

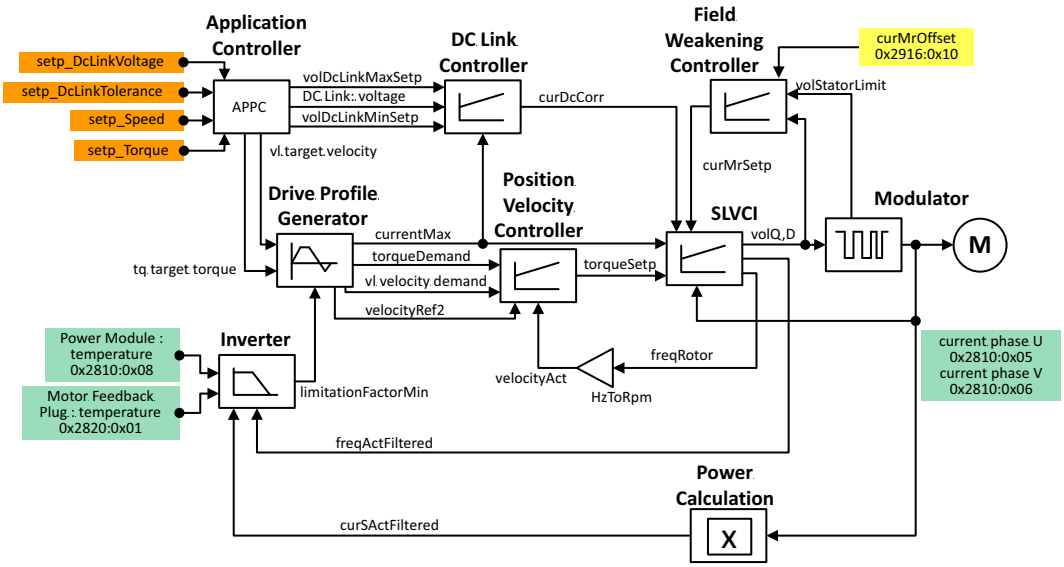
▸ VCI - Vector control for asynchronous motors (📖 123)

Possible CiA402 operating modes with this control mode:

CiA402 operating mode (Mode of operation)	Control system				
	SLVFCI	SLVCI	VCI	SLVCS	VCS
Velocity Mode	●	●	●	●	●
Profile Torque Mode	-	●	●	●*	●
Cyclic Synchronous Position Mode	-	-	●	-	●
Generator Mode	●	●	●	●	●

* not at speeds around 0 rpm

Signal flow



Links:

Application Controller:	DC Link Controller:	Field Weakening Controller:
Application controller	DC link controller	Field weakening controller
Drive Profile Generator	Position Controller: Position controller	Function SLVCI
Inverter	Velocity Controller: Velocity controller	Power Calculation: Power calculation

[6-9] Overview of signal flow for sensorless vector control for asynchronous motors (simplified representation)

Input variables via Public CAN

Name	Info	Further information
setp_DcLinkVoltage	Setpoint for DC-bus voltage	▸ Status of the master control
setp_DcLinkTolerance	This value is added to the *setp_DcLinkVoltage* setpoint or subtracted in order to obtain the maximum and minimum value of the DC-bus voltage required for derating.	▸ Setpoints for motor A ▸ Setpoints for motor B
setp_Speed	Velocity Mode: Speed setpoint Profile Torque Mode: Upper speed limit for speed limitation	
setp_Torque	Profile Torque Mode: Torque setpoint	

Description of the parameters

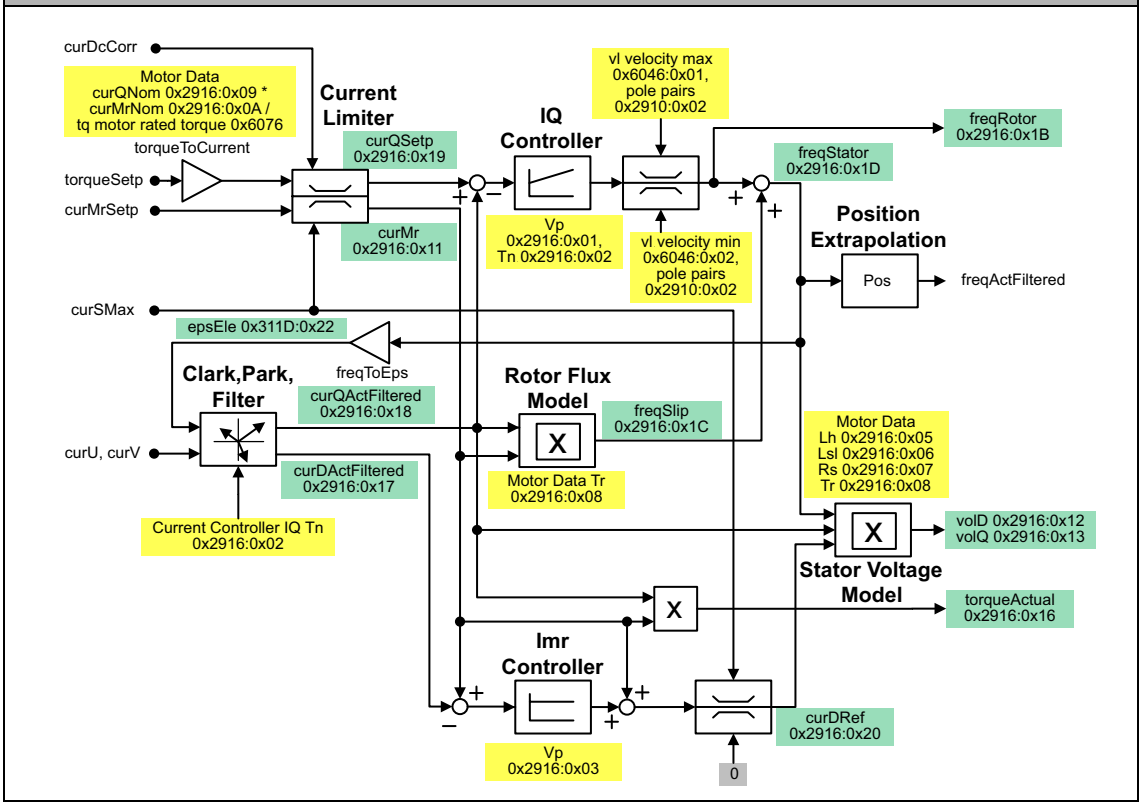
0x2916 | 0x3116 - Motor A/B SLVCI

Subindex 0x10: **curMrOffset**			
Magnetising current setpoint			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 200 A	10 A	REAL32

6.9.1 Function SLVCI

The current limiter limits the setpoints for the torque-producing and the field-producing current on the basis of the maximum current. Separate, decoupled controllers regulate the actual currents to the limited setpoint currents. The voltages are calculated in the stator voltage model. The slip is calculated with the rotor flow model and from it, the actual speed.

Signal flow



[6-10] Signal flow for function block SLVCI (simplified representation)

Description of the parameters

0x2916 | 0x3116 - Motor A/B SLVCI

Sub.	Name	Default setting	Data type
▸ 0x01	Current Controller IQ Vp	0.5 Hz/A	REAL32
▸ 0x02	Current Controller IQ Tn	1 s	REAL32
▸ 0x03	Current Controller Imr Vp	1	REAL32
▸ 0x05	Motor Data Lh	500 mH	REAL32
▸ 0x06	Motor Data Lsl	500 mH	REAL32
▸ 0x07	Motor Data Rs	500 mOhm	REAL32
▸ 0x08	Motor Data Tr	0.05 s	REAL32
▸ 0x09	Motor Data curQNom	50 A	REAL32
▸ 0x0A	Motor Data curMrNom	10 A	REAL32
▸ 0x0B	curMrLoadFactor	0	REAL32
▸ 0x10	curMrOffset	10 A	REAL32

Subindex 0x01: **Current Controller IQ Vp**			
Current controller (d component): Gain Vp • The controller is designed as a PI controller.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 1000 Hz/A	0.5 Hz/A	REAL32

Subindex 0x02: **Current Controller IQ Tn**			
Current controller (d component): Reset time Tn • The controller is designed as a PI controller.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 100 s	1 s	REAL32

Current controller (q component): Gain Vp • The controller is designed as P controller.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 2	1	REAL32

Subindex 0x05: **Motor Data Lh**			
Motor magnetising inductance			
Scaling factor	Setting range	Default setting	Data type
1000	0 ... 1000 mH	500 mH	REAL32

Subindex 0x06: **Motor Data Lsl**			
Motor stator leakage inductance			
Scaling factor	Setting range	Default setting	Data type
1000	0 ... 1000 mH	500 mH	REAL32

Subindex 0x07: **Motor Data Rs**			
Motor stator resistance			
Scaling factor	Setting range	Default setting	Data type
1000	0 ... 50000 mOhm	500 mOhm	REAL32

Subindex 0x08: **Motor Data Tr**			
Motor rotor time constant			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 5 s	0.05 s	REAL32

Subindex 0x09: **Motor Data curQNom**			
Nominal current (q component)			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 200 A	50 A	REAL32

Subindex 0x0A: **Motor Data curMrNom**			
Nominal magnetising current			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 200 A	10 A	REAL32

Subindex 0x0B: **curMrLoadFactor**			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 2	0	REAL32

Subindex 0x10: **curMrOffset**			
Magnetising current setpoint			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 200 A	10 A	REAL32

6.10 VCI - Vector control for asynchronous motors

Objects described in this chapter and their availability for the MOBILE devices:

Object	Name	MOBILE			
		DCU	PSU	DCU PSU	DCU S
0x291E	Motor VCI INV A	●			
0x311E	Motor VCI INV B	●		●	

The vector control for asynchronous motors (VCI) is based on a decoupled, separate control of the torque-generating and the field-generating current component. The motor control is based on a field-oriented, cascaded controller structure with feedback function and enables dynamic and stable operation in all of the four quadrants.

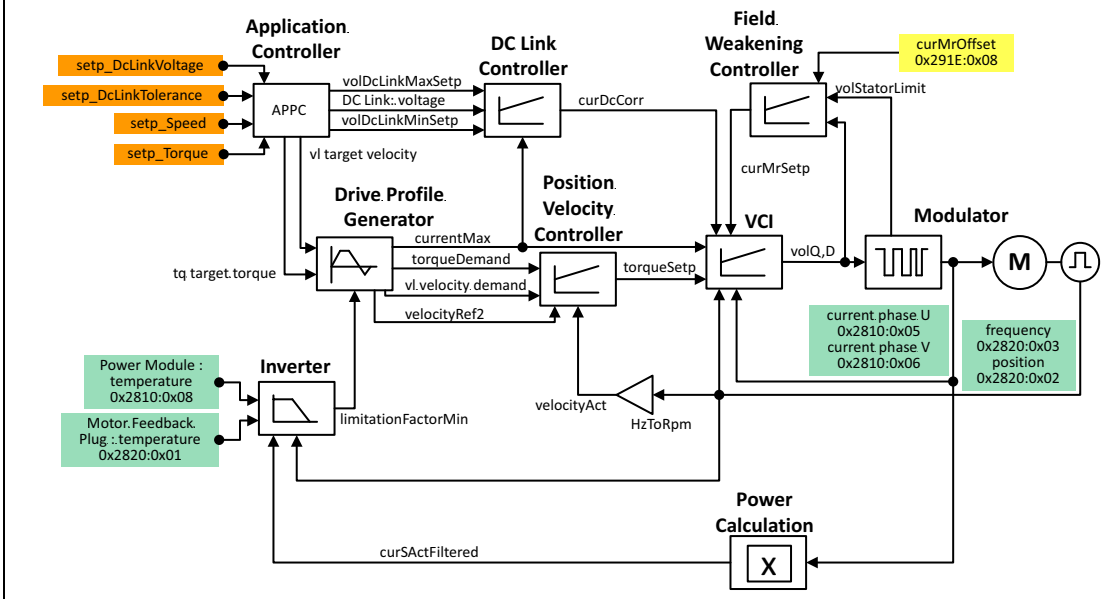
in comparison to the sensorless vector control, the following can be achieved by means of this control

- A higher maximum torque throughout the entire speed range
- A higher speed accuracy
- A higher concentricity factor
- A higher level of efficiency
- An optimum control even at speeds around 0 rpm.

Possible CiA402 operating modes with this control mode:

CiA402 operating mode (Mode of operation)	Control system				
	SLVFCI	SLVCI	VCI	SLVCS	VCS
Velocity Mode	●	●	●	●	●
Profile Torque Mode	-	●	●	●*	●
Cyclic Synchronous Position Mode	-	-	●	-	●
Generator Mode	●	●	●	●	●
					* not at speeds around 0 rpm

Signal flow



Links:

Application Controller:
Application controller
Drive Profile Generator
Inverter

DC Link Controller:
DC link controller
Position Controller:
Position controller
Velocity Controller:
Velocity controller

Field Weakening Controller:
Field weakening controller
Power Calculation:
Power calculation

[6-11] Overview of signal flow for vector control for asynchronous motors (simplified representation)

Input variables via Public CAN

Name	Info	Further information
setp_DcLinkVoltage	Setpoint for DC-bus voltage	▸ Status of the master control
setp_DcLinkTolerance	This value is added to the *setp_DcLinkVoltage* setpoint or subtracted in order to obtain the maximum and minimum value of the DC-bus voltage required for derating.	▸ Setpoints for motor A ▸ Setpoints for motor B
setp_Speed	Velocity Mode: Speed setpoint Profile Torque Mode: Speed limit for speed limitation	
setp_Torque	Profile Torque Mode: Torque setpoint	

Description of the parameters

0x291E | 0x311E - Motor A/B VCI

Sub.	Name	Default setting	Data type
▸ 0x01	Current Controller ID Vp	1 V/A	REAL32
▸ 0x02	Current Controller ID Tn	0.01 s	REAL32
▸ 0x03	Current Controller IQ Vp	1 V/A	REAL32
▸ 0x04	Current Controller IQ Tn	0.01 s	REAL32
▸ 0x05	Motor Data Tr	0.05 s	REAL32
▸ 0x06	Motor Data curQNom	50 A	REAL32
▸ 0x07	Motor Data curMrNom	10 A	REAL32
▸ 0x08	curMrOffset	10 A	REAL32
▸ 0x09	curMrLoadFactor	0	REAL32
▸ 0x0A	Current Controller Imr Vp	1	REAL32

Subindex 0x01: **Current Controller ID Vp**			
Current controller (d component): Gain Vp • The controller is designed as a PI controller.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 1000 V/A	1 V/A	REAL32

Subindex 0x02: **Current Controller ID Tn**			
Current controller (d component): Reset time Tn • The controller is designed as a PI controller.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 100 s	0.01 s	REAL32

Subindex 0x03: **Current Controller IQ Vp**			
Current controller (q component): Gain Vp • The controller is designed as a PI controller.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 1000 V/A	1 V/A	REAL32

Subindex 0x04: **Current Controller IQ Tn**			
Current controller (q component): Reset time Tn • The controller is designed as a PI controller.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 100 s	0.01 s	REAL32

Subindex 0x05: **Motor Data Tr**			
Motor rotor time constant			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 5 s	0.05 s	REAL32

Subindex 0x06: **Motor Data curQNom**			
Nominal current (q component)			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 200 A	50 A	REAL32

Subindex 0x07: **Motor Data curMrNom**			
Nominal magnetising current			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 200 A	10 A	REAL32

Subindex 0x08: **curMrOffset**			
Magnetising current setpoint			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 200 A	10 A	REAL32

Subindex 0x09: **curMrLoadFactor**			
Load factor of the magnetising current • (curMrRef = curMrOffset + |curQSetpoint| * curMrLoadFactor)			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 2	0	REAL32

Scaling factor	Setting range	Default setting	Data type
1	0 ... 10	1	REAL32

6.11 SLVCS - Sensorless vector control for synchronous motors

Objects described in this chapter and their availability for the MOBILE devices:

Object	Name	MOBILE			
		DCU	PSU	DCU PSU	DCU S
0x291A	Motor SLVCS (Position Velocity Observer) INV A	●			●
0x311A	Motor SLVCS (Position Velocity Observer) INV B	●		●	

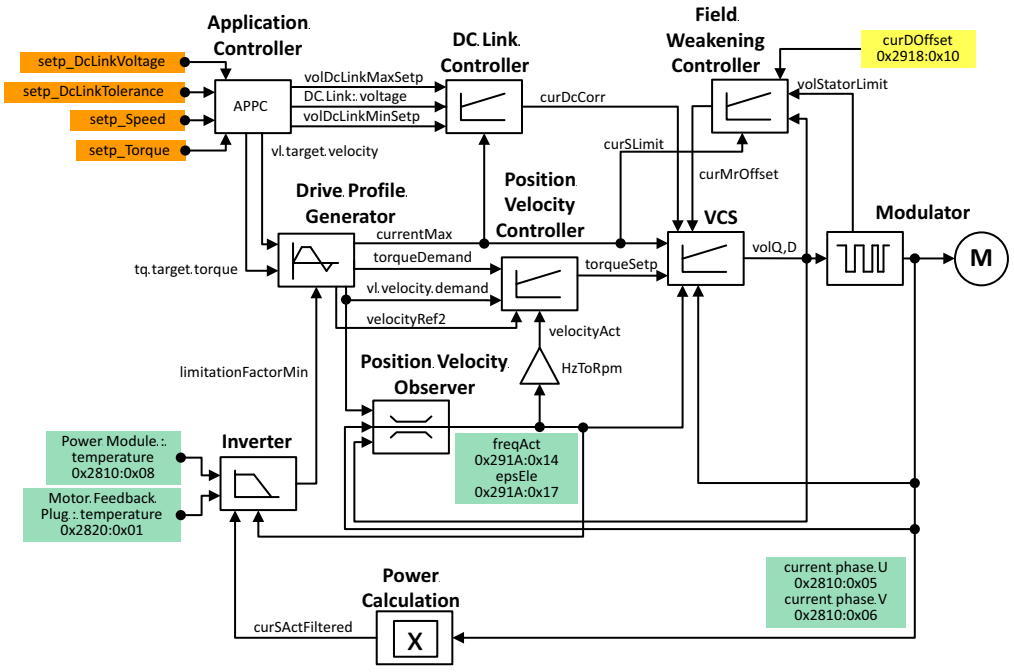
The sensorless vector control for synchronous motors is based on a decoupled and separated control of the torque-generating current component and current in the field direction. In contrast to the servo control, the actual speed value and the rotor position are reconstructed via a motor model.

Possible CiA402 operating modes with this control mode:

CiA402 operating mode (Mode of operation)	Control system				
	SLVFCI	SLVCI	VCI	SLVCS	VCS
Velocity Mode	●	●	●	●	●
Profile Torque Mode	-	●	●	●*	●
Cyclic Synchronous Position Mode	-	-	●	-	●
Generator Mode	●	●	●	●	●

* not at speeds around 0 rpm

Signal flow



Links:

Application Controller: Application controller	DC Link Controller: DC link controller	Field Weakening Controller: Field weakening controller
Drive Profile Generator	Position Velocity Observer: Position velocity observer	Position Controller: Position controller
Inverter	Power Calculation: Power calculation	Velocity Controller: Velocity controller

[6-12] Overview of signal flow for sensorless vector control for synchronous motors (simplified representation)

Input variables via Public CAN

Name	Info	Further information
setp_DcLinkVoltage	Setpoint for DC-bus voltage	▸ Status of the master control
setp_DcLinkTolerance	This value is added to the *setp_DcLinkVoltage* setpoint or subtracted in order to obtain the maximum and minimum value of the DC-bus voltage required for derating.	▸ Setpoints for motor A ▸ Setpoints for motor B
setp_Speed	Velocity Mode: Speed setpoint Profile Torque Mode: Speed limit for speed limitation	
setp_Torque	Profile Torque Mode: Torque setpoint	

Description of the parameters

0x2918 | 0x3118 - Motor A/B VCS

Sub.	Name	Default setting	Data type
▸ 0x06	Current Controller ID Vp	1 V/A	REAL32
▸ 0x07	Current Controller ID Tn	0.01 s	REAL32
▸ 0x0A	Current Controller IQ Vp	1 V/A	REAL32
▸ 0x0B	Current Controller IQ Tn	0.01 s	REAL32
▸ 0x0C	Decoupling Vp	0.9	REAL32
▸ 0x10	curDOffset	0 A	INT16
▸ 0x12	Motor Data Rotor Flux	0.6666 Vs	REAL32
▸ 0x13	Motor Data Ld	0 mH	REAL32
▸ 0x14	Motor Data Lq	0 mH	REAL32

Subindex 0x06: **Current Controller ID Vp**			
Current controller (d component): Gain Vp • The controller is designed as a PI controller.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 1000 V/A	1 V/A	REAL32

Subindex 0x07: **Current Controller ID Tn**			
Current controller (d component): Reset time Tn • The controller is designed as a PI controller.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 100 s	0.01 s	REAL32

Subindex 0x0A: **Current Controller IQ Vp**			
Current controller (q component): Gain Vp • The controller is designed as a PI controller.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 1000 V/A	1 V/A	REAL32

Subindex 0x0B: **Current Controller IQ Tn**			
Current controller (q component): Reset time Tn • The controller is designed as a PI controller.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 100 s	0.01 s	REAL32

Subindex 0x0C: **Decoupling Vp**			
Gain Vp of the decoupling			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 2	0.9	REAL32

Subindex 0x10: **curDOffset**			
Feedforward control of the field weakening controller			
Scaling factor	Setting range	Default setting	Data type
1.562500000000E-002	-200 ... 200 A	0 A	INT16

Subindex 0x12: **Motor Data Rotor Flux**			
Setpoint flux for rotor flux model			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 1 Vs	0.6666 Vs	REAL32

Subindex 0x13: **Motor Data Ld**			
Stator inductance of the D-axis			
Scaling factor	Setting range	Default setting	Data type
1000	0 ... 1000 mH	0 mH	REAL32

Subindex 0x14: **Motor Data Lq**			
Stator inductance of the Q-axis			
Scaling factor	Setting range	Default setting	Data type
1000	0 ... 1000 mH	0 mH	REAL32

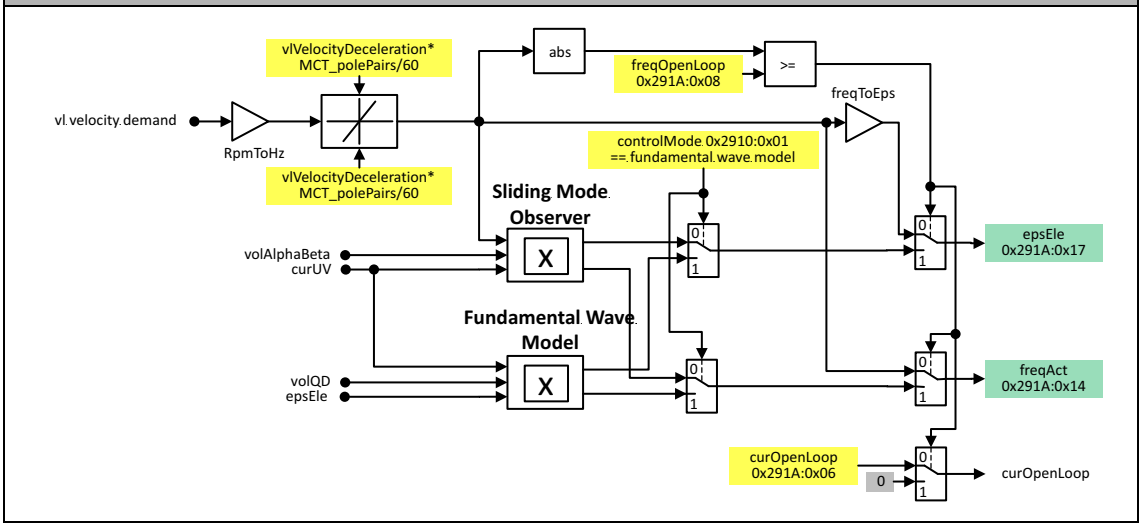
6.11.1 Position velocity observer

The fundamental wave model and the Sliding Mode Observer are available to monitor the actual speed.

- The fundamental wave model is suitable for applications with high stator frequencies.
- The Sliding Mode Observer is suitable for low stator frequencies.
  - Advantages: very fast transient oscillation (e.g. on a still-rotating machine), easy parameter setting.
  - Disadvantage: rather “uneasy" angle.

The current speed and the position cannot be determined with the position velocity observer at a low speed. This is why a D current vector with the length curOpenLoop is specified in the range |freqSetp| < freqOpenLoop to control the machine.

Signal flow



[6-13] Overview of signal flow for sensorless vector control for synchronous motors (simplified representation)

Description of the parameters

0x291A | 0x311A - Motor A/B Position Velocity Observer

Sub.	Name	Default setting	Data type
▸ 0x01	Motor Data Ls	500 mH	REAL32
▸ 0x02	Motor Data Rs	500 mOhm	REAL32
▸ 0x03	k	100	REAL32
▸ 0x04	filter tau	0.1 s	REAL32
▸ 0x05	alignTime	0.1024 s	UNSIGNED16
▸ 0x06	curOpenLoop	10 A	REAL32

Sub.	Name	Default setting	Data type
▸ 0x07	volEMFMin	10 V	INT16
▸ 0x08	freqOpenLoop	10 Hz	REAL32
▸ 0x09	Ke	0.5 V/rad	REAL32
▸ 0x0A	Tracking Controller Vp	2	REAL32
▸ 0x0B	Tracking Controller Tn	0.005 s	REAL32
▸ 0x0C	Motor Data Ld	500 mH	REAL32
▸ 0x0D	Motor Data Lq	500 mH	REAL32
▸ 0x0E	freqSlopeOpenLoop	0 Hz/s	REAL32

Subindex 0x01: **Motor Data Ls**			
Stator inductance			
Scaling factor	Setting range	Default setting	Data type
1000	0 ... 1000 mH	500 mH	REAL32

Subindex 0x02: **Motor Data Rs**			
Stator resistance			
Scaling factor	Setting range	Default setting	Data type
1000	0 ... 50000 mOhm	500 mOhm	REAL32

Subindex 0x03: **k**			
k factor for the sliding mode controller			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 1000	100	REAL32

Subindex 0x04: **filter tau**			
Time constant of the sliding mode observer			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 1 s	0.1 s	REAL32

Subindex 0x05: **alignTime**			
Motor alignment time (only if a machine standstill has been detected after controller enable)			
Scaling factor	Setting range	Default setting	Data type
1.0240000000000E-003	0 ... 5.12 s	0.1024 s	UNSIGNED16

Subindex 0x06: **curOpenLoop**			
Current setpoint in open loop mode			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 200 A	10 A	REAL32

Subindex 0x07: **volEMFMin**			
Minimum machine e.m.f. for standstill detection			
Scaling factor	Setting range	Default setting	Data type
6.250000000000E-002	0 ... 500 V	10 V	INT16

Subindex 0x08: **freqOpenLoop**			
Electrical frequency threshold in open loop mode			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 2000 Hz	10 Hz	REAL32

Subindex 0x09: **Ke**			
Voltage constant (stator peak voltage at each electric speed)			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 10 V/rad	0.5 V/rad	REAL32

Subindex 0x0A: **Tracking Controller Vp**			
Correction controller gain Vp of the fundamental wave model			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 2000	2	REAL32

Subindex 0x0B: **Tracking Controller Tn**			
Correction controller reset time Tn of the fundamental wave model			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 2000 s	0.005 s	REAL32

Subindex 0x0C: **Motor Data Ld**			
Stator inductance of the D-axis			
Scaling factor	Setting range	Default setting	Data type
1000	0 ... 1000 mH	500 mH	REAL32

Subindex 0x0D: **Motor Data Lq**			
Stator inductance of the Q-axis			
Scaling factor	Setting range	Default setting	Data type
1000	0 ... 1000 mH	500 mH	REAL32

Subindex 0x0E: **freqSlopeOpenLoop**			
Electrical frequency slope in the open loop mode (follows the input directly if set to 0)			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 10000 Hz/s	0 Hz/s	REAL32

6.12 VCS - Vector control for synchronous motors

Objects described in this chapter and their availability for the MOBILE devices:

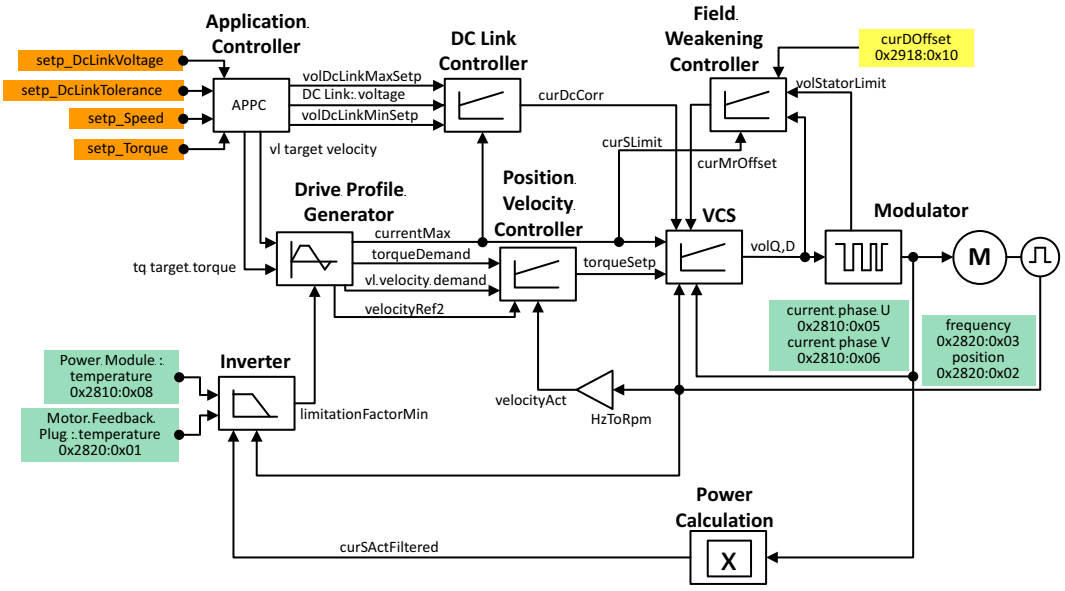
Object	Name	MOBILE			
		DCU	PSU	DCU PSU	DCU S
0x2918	Motor VCS INV A	●			
0x3118	Motor VCS INV B	●		●	

Possible CiA402 operating modes with this control mode:

CiA402 operating mode (Mode of operation)	Control system				
	SLVFCI	SLVCI	VCI	SLVCS	VCS
Velocity Mode	●	●	●	●	●
Profile Torque Mode	-	●	●	●*	●
Cyclic Synchronous Position Mode	-	-	●	-	●
Generator Mode	●	●	●	●	●

* not at speeds around 0 rpm

Signal flow



Links:

Application Controller:
Application controller

Drive Profile Generator

Inverter

DC Link Controller:
DC link controller

Position Controller:
Position controller

Velocity Controller:
Velocity controller

Field Weakening Controller:
Field weakening controller

Power Calculation:
Power calculation

[6-14] Overview of signal flow for sensorless vector control for synchronous motors (simplified representation)

Input variables via Public CAN

Name	Info	Further information
setp_DcLinkVoltage	Setpoint for DC-bus voltage	▸ Status of the master control
setp_DcLinkTolerance	This value is added to the *setp_DcLinkVoltage* setpoint or subtracted in order to obtain the maximum and minimum value of the DC-bus voltage required for derating.	▸ Setpoints for motor A ▸ Setpoints for motor B
setp_Speed	Velocity Mode: Speed setpoint Profile Torque Mode: Speed limit for speed limitation	
setp_Torque	Profile Torque Mode: Torque setpoint	

Description of the parameters

0x2918 | 0x3118 - Motor A/B VCS

Sub.	Name	Default setting	Data type
▸ 0x06	Current Controller ID Vp	1 V/A	REAL32
▸ 0x07	Current Controller ID Tn	0.01 s	REAL32
▸ 0x0A	Current Controller IQ Vp	1 V/A	REAL32
▸ 0x0B	Current Controller IQ Tn	0.01 s	REAL32
▸ 0x0C	Decoupling Vp	0.9	REAL32
▸ 0x10	curDOffset	0 A	INT16
▸ 0x12	Motor Data Rotor Flux	0.6666 Vs	REAL32
▸ 0x13	Motor Data Ld	0 mH	REAL32
▸ 0x14	Motor Data Lq	0 mH	REAL32

Subindex 0x06: **Current Controller ID Vp**			
Current controller (d component): Gain Vp • The controller is designed as a PI controller.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 1000 V/A	1 V/A	REAL32

Subindex 0x07: **Current Controller ID Tn**			
Current controller (d component): Reset time Tn • The controller is designed as a PI controller.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 100 s	0.01 s	REAL32

Subindex 0x0A: **Current Controller IQ Vp**			
Current controller (q component): Gain Vp • The controller is designed as a PI controller.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 1000 V/A	1 V/A	REAL32

Subindex 0x0B: **Current Controller IQ Tn**			
Current controller (q component): Reset time Tn • The controller is designed as a PI controller.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 100 s	0.01 s	REAL32

Subindex 0x0C: **Decoupling Vp**			
Gain Vp of the decoupling			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 2	0.9	REAL32

Subindex 0x10: **curDOffset**			
Feedforward control of the field weakening controller			
Scaling factor	Setting range	Default setting	Data type
1.562500000000E-002	-200 ... 200 A	0 A	INT16

Subindex 0x12: **Motor Data Rotor Flux**			
Setpoint flux for rotor flux model			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 1 Vs	0.6666 Vs	REAL32

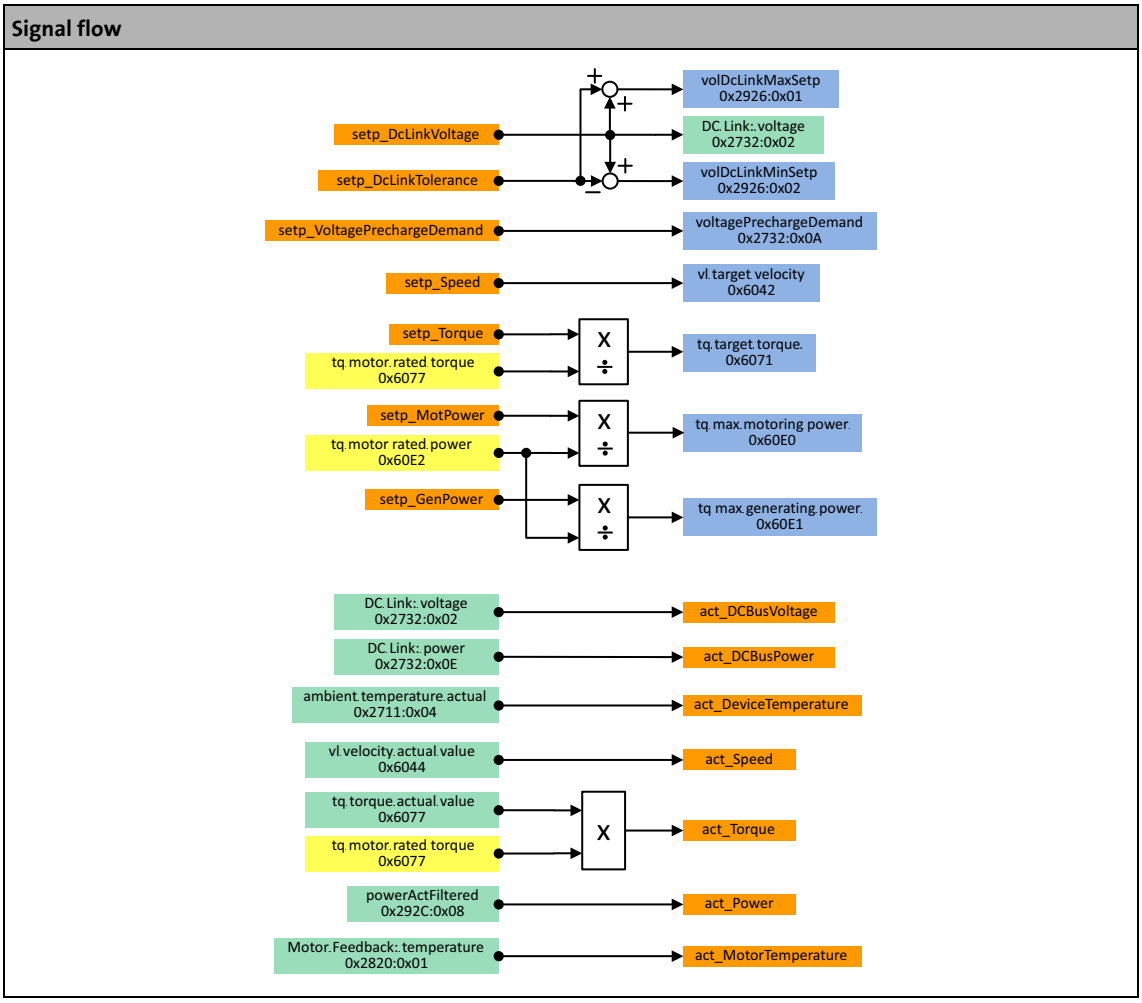
Subindex 0x13: **Motor Data Ld**			
Stator inductance of the D-axis			
Scaling factor	Setting range	Default setting	Data type
1000	0 ... 1000 mH	0 mH	REAL32

Subindex 0x14: **Motor Data Lq**			
Stator inductance of the Q-axis			
Scaling factor	Setting range	Default setting	Data type
1000	0 ... 1000 mH	0 mH	REAL32

6.13 Application controller

The setpoints from the Public CAN are offset in the Application Controller and forwarded via Private CAN to the Motor Controller (MC).

Signal flow



[6-15] Signal flow for application controller

Note!

The power limitation functions *setp_MotPower* and *setp_GenPower* are only available as of firmware 6.1.

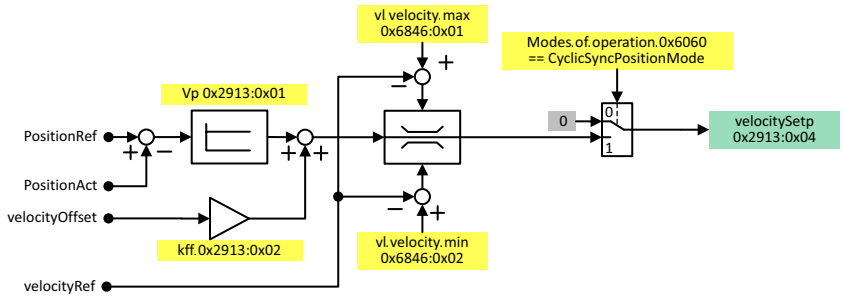
6.14 Position controller

Objects described in this chapter and their availability for the MOBILE devices:

Object	Name	MOBILE			
		DCU	PSU	DCU PSU	DCU S
0x2913	Motor PositionControl INV A	●			●
0x3113	Motor PositionControl INV B	●		●	

The position controller is only active in the "Cyclic Synchronous Position Mode" operating mode and defines the setpoint speed *velocitySetp*.

Signal flow



[6-16] Signal flow for position controller

Description of the parameters

0x2913 | 0x3113 - Motor A/B Position Controller

Sub.	Name	Default setting	Data type
▸ 0x01	Vp	0.3 (rev/min)/rad	REAL32
▸ 0x02	Kff	0.9	REAL32

Subindex 0x01: **Vp**			
Position controller: Gain Vp • The controller is designed as P controller with feedforward control.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 1000 (rev/min)/rad	0.3 (rev/min)/rad	REAL32

Subindex 0x02: **Kff**			
Position controller: Gain Kff for feedforward control • The controller is designed as P controller with feedforward control.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 2	0.9	REAL32

6.15 Velocity controller

Objects described in this chapter and their availability for the MOBILE devices:

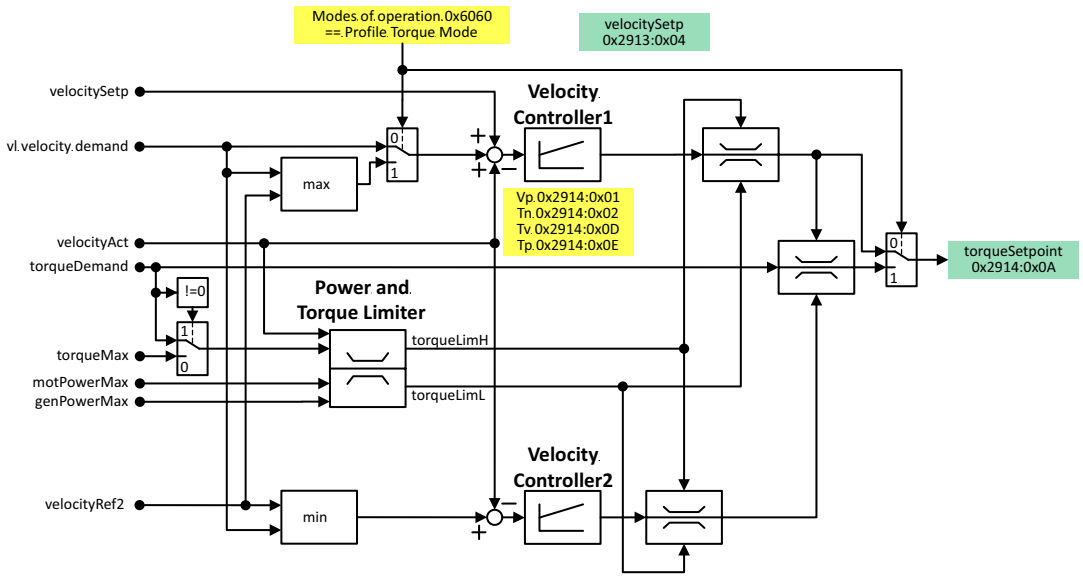
Object	Name	MOBILE			
		DCU	PSU	DCU PSU	DCU S
0x2914	Motor VelocityControl INV A	●			●
0x3114	Motor VelocityControl INV B	●		●	

In the "Velocity Mode" operating mode , the setpoint speed is defined via vl velocity demand. The *Velocity Controller1* controls the speed and defines the setpoint torque *torqueSetpoint*.

The torque setpoint sent in torqueDemand is effective in the operating modes "Velocity Mode", "Generator Mode" and "Cyclic Synchronous Position Mode" as a torque limitation.

The *Velocity Controller2* is only active in the "Profile Torque Mode" and "Generator Mode" and then realizes the lower speed limitation. At the vl velocity demand and velocityRef2 inputs, the higher value is the upper speed limit and the lower value the lower speed limit.

Signal flow



Links: Power and Torque Limiter:
Power and torque limiter

[6-17] Signal flow for velocity controller

Description of the parameters

0x2914 | 0x3114 - Motor A/B Velocity Controller

Sub.	Name	Default setting	Data type
▸ 0x01	Vp	0.1 Nm/(rev/min)	REAL32
▸ 0x02	Tn	0.5 s	REAL32
▸ 0x0D	Tv	0 s	REAL32
▸ 0x0E	Tp	0.001 s	REAL32

Subindex 0x01: Vp

Velocity controller: gain Vp
- The controller is designed as a PID controller.

Scaling factor	Setting range	Default setting	Data type
1	0 ... 1000 Nm/(rev/min)	0.1 Nm/(rev/min)	REAL32

Subindex 0x02: Tn

Velocity controller: reset time Tn
- The controller is designed as a PID controller.

Scaling factor	Setting range	Default setting	Data type
1	0 ... 100 s	0.5 s	REAL32

Subindex 0x0D: Tv

Velocity controller: rate time Tv
- The controller is designed as a PID controller.

Scaling factor	Setting range	Default setting	Data type
1	0 ... 1 s	0 s	REAL32

Subindex 0x0E: Tp

Velocity controller: parasitic time constant Tp
- The controller is designed as a PID controller.

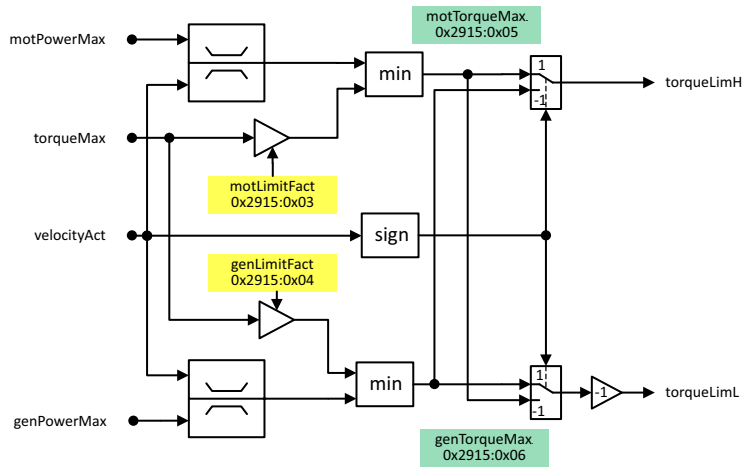
Scaling factor	Setting range	Default setting	Data type
1	0.000256 ... 1 s	0.001 s	REAL32

6.16 Power and torque limiter

The setpoints motPowerMax and genPowerMax act as motor-driven or regenerative power limits. The motor or regenerative torque limit motTorqueMax or genTorqueMax is calculated from these using the current speed and the current absolute torque limit.

The power and torque limitation does not work in all operating modes. In "Generator Mode" and with the control mode SLVFCI, the power or torque can only be limited using the maximum current.

Signal flow



[6-18] Signal flow for power and torque limiter

Description of the parameters

0x2915 | 0x3115 - Motor A/B Power and Torque Limiter

Sub.	Name	Default setting	Data type
▸ 0x03	motLimitFactor	1	REAL32
▸ 0x04	genLimitFactor	1	REAL32

Subindex 0x03: **motLimitFactor**			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 1	1	REAL32

Subindex 0x04: **genLimitFactor**			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 1	1	REAL32

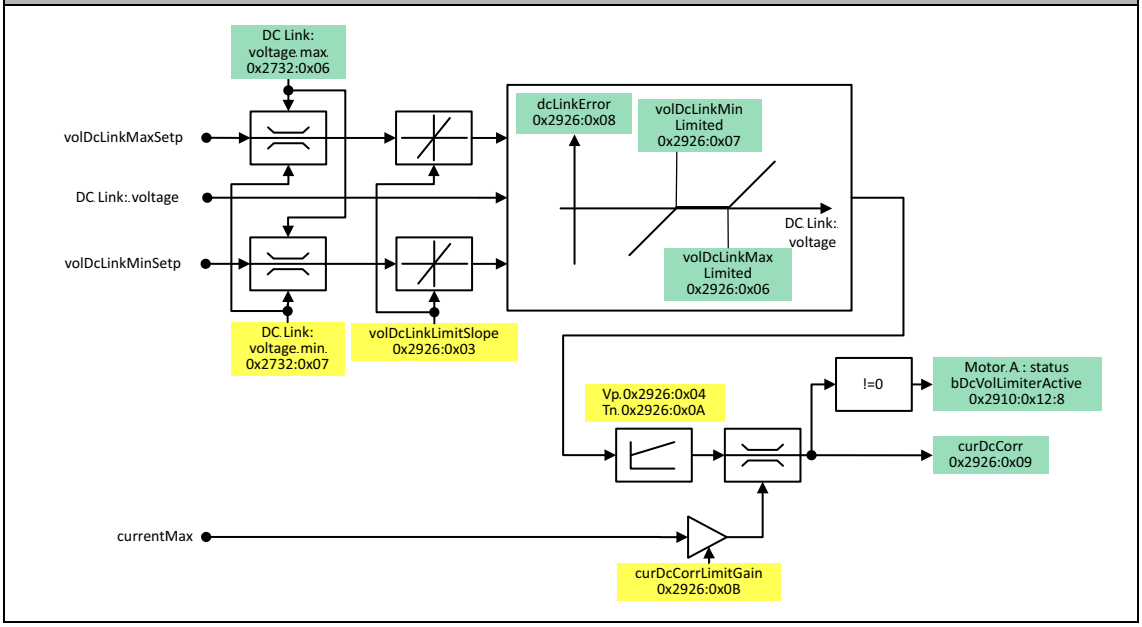
6.17 DC link controller

Objects described in this chapter and their availability for the MOBILE devices:

Object	Name	MOBILE			
		DCU	PSU	DCU PSU	DCU S
0x2926	Motor DC Link Controller INV A	●			●
0x3126	Motor DC Link Controller INV B	●		●	

Depending on the setpoints for the maximum and minimum DC link voltage, the DC link controller calculates a correction current. The motor control active in each case responds to this correction current such that the DC-bus voltage moves towards the permitted area.

Signal flow



[6-19] Signal flow for DC link controller

Description of the parameters

Stop!

The HV DC-bus voltage may rise to an impermissibly high value when the motor is braked (drive torque < 0) and damage other devices in the HV DC bus.

- Parameterize the DC link controller correctly so that the HV DC link voltage is limited to the max. permissible value.

0x2926 | 0x3126 - Motor A/B DC Link Controller

Sub.	Name	Default setting	Data type
▸ 0x03	volDcLinkLimitSlope	1000 V/s	REAL32
▸ 0x04	Vp	1 A/V	REAL32
▸ 0x0A	Tn	0.1 s	REAL32
▸ 0x0B	curDcCorrLimitGain	1	REAL32

Subindex 0x03: volDcLinkLimitSlope

Ramp for the maximum change of the DC-bus voltage limits
- If the setting is "0", no ramp limitation is active and the DC-bus voltage limits directly follow the setpoint.

Scaling factor	Setting range	Default setting	Data type
1	0 ... 100000 V/s	1000 V/s	REAL32

Subindex 0x04: Vp

DC-bus controller: Gain Vp
- The controller is designed as PI controller with deadband.
- Depending on the setpoints for the maximum and minimum DC-bus voltage, the controller calculates a correction current. The motor control active in each case responds to this correction current such that the DC-bus voltage moves towards the permitted area.

Scaling factor	Setting range	Default setting	Data type
1	0 ... 100 A/V	1 A/V	REAL32

Subindex 0x0A: Tn

DC-bus controller: Reset time Tn
- The controller is designed as PI controller with deadband.

Scaling factor	Setting range	Default setting	Data type
1	0 ... 100 s	0.1 s	REAL32

Subindex 0x0B: curDcCorrLimitGain

Current limitation factor for the DC bus control

Scaling factor	Setting range	Default setting	Data type
1	0.1 ... 1.1	1	REAL32

6.18 Field weakening controller

Objects described in this chapter and their availability for the MOBILE devices:

Object	Name	MOBILE			
		DCU	PSU	DCU PSU	DCU S
0x2928	Motor Field Weakening Controller INV A	●			●
0x3128	Motor Field Weakening Controller INV B	●		●	

For this purpose, the field is weakened with negative D current in case of a synchronous motor and with a lower magnetizing current in case of an asynchronous motor. The field weakening controller provides for the desired speed even if the DC link voltage is limited. As a result, the same speed can be achieved with a lower stator voltage.

The Motor Controller reports via bit 8 of the drive profile parameter "Drive Profile Inverter A/B statusword" (INV A: object 0x6041, INV B: 0x6841) if it is in the field weakening operation.

Note!

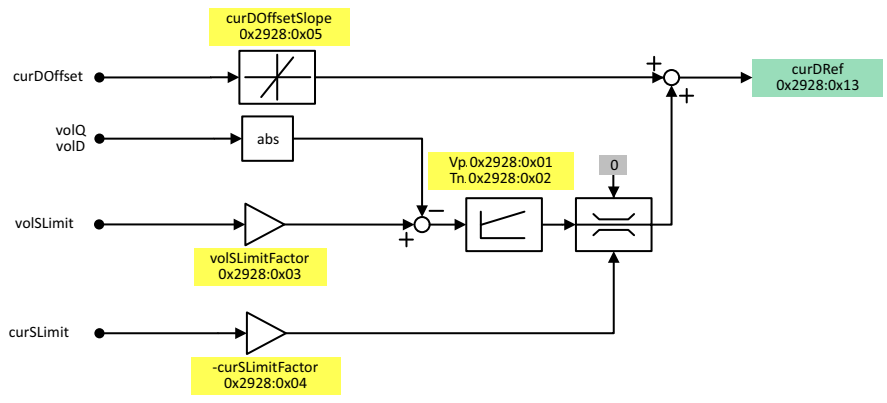
In order that no overvoltages take place in the DC bus, make sure that the motor control in the field-weakened operation will not be interrupted. Thus, the state machine of the inverter will be kept in the "Fault Reaction Active" state if a switch-off command or an error is pending until the speed of the machine has fallen below the field weakening speed.

In this case, the Motor Controller changes to the "Fault Reaction" state and reduces the torque to 0, while the field weakening remains active. After the stator voltage has dropped and the field weakening has been reduced to 0, the "Fault Reaction" state changes to the "Fault" state. The Motor Controller transmits an error message.

Only if the following errors occur, the output stage is switched off immediately and the Motor Controller changes to the "Fault" state:

- Short circuit/overcurrent (HW and SW monitoring)
- DC-bus overvoltage (HW and SW monitoring)

Signal flow



[6-20] Signal flow for field weakening controller

Description of the parameters

0x2928 | 0x3128 - Motor A/B Field Weakening Controller

Sub.	Name	Default setting	Data type
▸ 0x01	Vp	0 A/V	REAL32
▸ 0x02	Tn	0 s	REAL32
▸ 0x03	volSLimitFactor	0.9	REAL32
▸ 0x04	curSLimitFactor	0.6	REAL32
▸ 0x05	curDOffsetSlope	1000 A/s	REAL32

Subindex 0x01: Vp

Field weakening controller: Gain Vp
- The controller is designed as a PI controller.

Scaling factor	Setting range	Default setting	Data type
1	0 ... 1000 A/V	0 A/V	REAL32

Subindex 0x02: Tn

Field weakening controller: Reset time Tn
- The controller is designed as a PI controller.

Scaling factor	Setting range	Default setting	Data type
1	0 ... 100 s	0 s	REAL32

Subindex 0x03: volSLimitFactor

This factor serves to determine how much of the currently maximally possible stator voltage defined by the DC-bus voltage and switching frequency is to be used.

Scaling factor	Setting range	Default setting	Data type
1	0 ... 1	0.9	REAL32

Subindex 0x04: curSLimitFactor

This factor serves to determine how much of the maximally possible stator current is to be used as field current.

Scaling factor	Setting range	Default setting	Data type
1	0 ... 1	0.6	REAL32

Subindex 0x05: curDOffsetSlope

Scaling factor	Setting range	Default setting	Data type
1	0 ... 3.40282347E+38 A/s	1000 A/s	REAL32

6.19 Flying restart circuit

Objects described in this chapter and their availability for the MOBILE devices:

Object	Name	MOBILE			
		DCU	PSU	DCU PSU	DCU S
0x292A	Motor Flying Restart Circuit INV A	●			●
0x312A	Motor Flying Restart Circuit INV B	●		●	

Before a sensorless control mode (SLVFCI, SLVCI) can be connected to an already rotating asynchronous motor without any jerk, its speed has to be detected. For this purpose, a flying restart circuit for estimating the speed can be carried out before the sensorless control is activated.

Note!

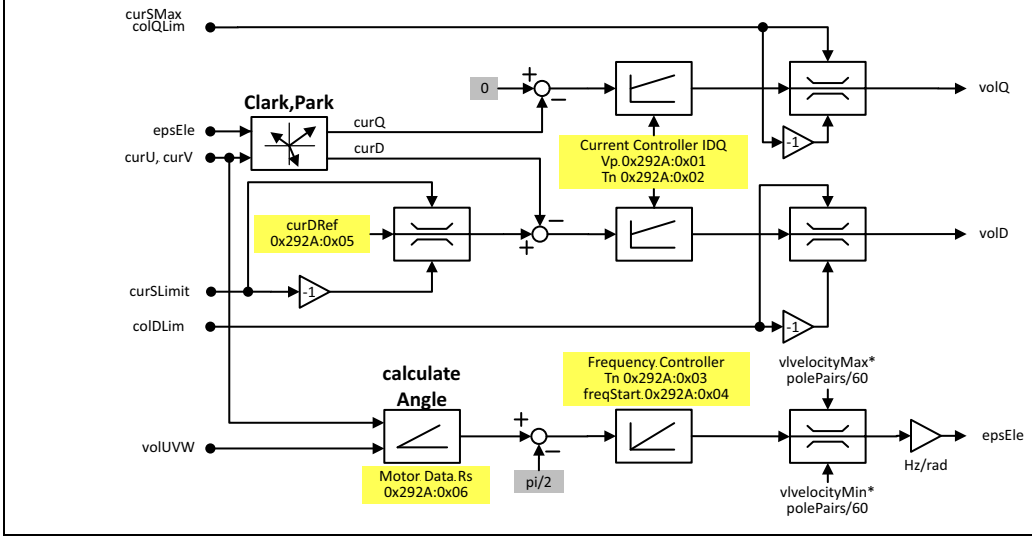
The flying restart circuit has the following restrictions:

- The start frequency must not be lower than the current frequency of the machine.
- The start frequency must have the correct sign.
- A residual remanence in the rotor of the machine can disturb the process.
- It is not checked whether the algorithm has converged. After the set timeout time, it is changed over to the control.

Activate flying restart

The flying restart circuit is activated via bit 14 of the "control mode" parameter (object 0x2910:0x01 or 0x3110:0x01 for DCU B). ▸ Overview of the control modes

Signal flow



[6-21] Signal flow for flying restart circuit

Description of the parameters

0x292A | 0x312A - Motor A/B Flying Restart Circuit

Sub.	Name	Default setting	Data type
▸ 0x01	Current Controller IDQ Vp	1 V/A	REAL32
▸ 0x02	Current Controller IDQ Tn	0.1 s	REAL32
▸ 0x03	Frequency Controller Tn	0.1 s	REAL32
▸ 0x04	freqStart	0 Hz	REAL32
▸ 0x05	curDRef	5 A	REAL32
▸ 0x06	Motor Data Rs	500 mOhm	REAL32
▸ 0x07	timeout time	3.072 s	UNSIGNED16

Subindex 0x01: **Current Controller IDQ Vp**			
Current controller (d and q component): Gain Vp • The controller is designed as a PI controller.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 1000 V/A	1 V/A	REAL32

Subindex 0x02: **Current Controller IDQ Tn**			
Current controller (d and q component): Reset time Tn • The controller is designed as a PI controller.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 100 s	0.1 s	REAL32

Subindex 0x03: **Frequency Controller Tn**			
Frequency controller: Reset time Tn • The controller is designed as I controller.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 100 s	0.1 s	REAL32

Subindex 0x04: **freqStart**			
Start frequency for flying restart circuit • The start frequency must not be lower than the current frequency of the machine. • The start frequency must have the correct sign.			
Scaling factor	Setting range	Default setting	Data type
1	-2000 ... 2000 Hz	0 Hz	REAL32

Subindex 0x05: **curDRef**			
Setpoint current (d component) for flying restart circuit			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 200 A	5 A	REAL32

Subindex 0x06: **Motor Data Rs**			
Motor stator resistance			
Scaling factor	Setting range	Default setting	Data type
1000	0 ... 50000 mOhm	500 mOhm	REAL32

Subindex 0x07: **timeout time**			
After the time set here has elapsed, it is changed over to the control.			
Scaling factor	Setting range	Default setting	Data type
1.0240000000000E-003	0.512 ... 10.24 s	3.072 s	UNSIGNED16

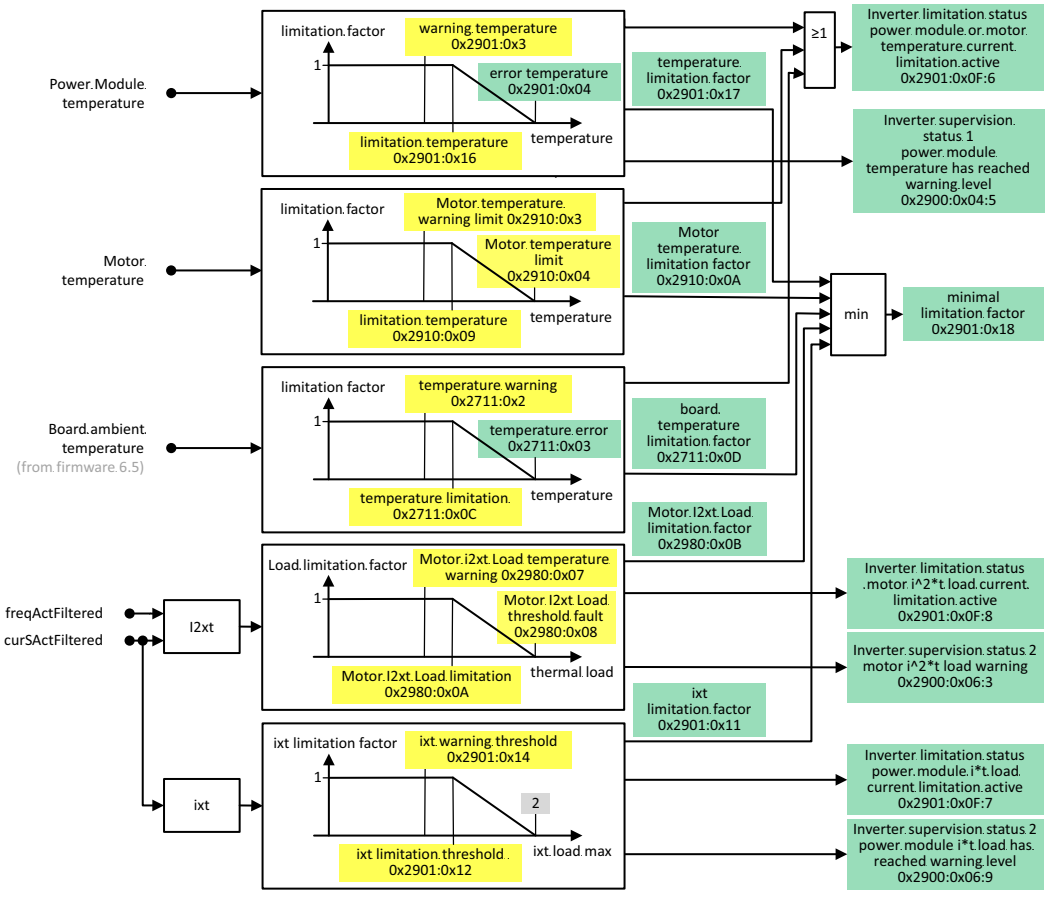
6.20 Inverter

The error, warning and limitation thresholds are essentially parameterisable, provided they are not non-adjustable for device protection (e.g. error threshold of the i×t-monitoring for the power section).

- Exceeding an error threshold: the inverter is switched off and the error is shown in MC status word 1 or MC status word 2.
- Exceeding a warning threshold: the inverter continues to run and the warning is shown in MC status word 1 or MC status word 2.
- Exceeding a limit threshold: the maximal possible output current currentMax is reduced linearly. This is shown in the limitation status and in Bit 11 of the drive profile parameter "Drive Profile Inverter A/B status word" (INV A: object 0x6041, INV B: 0x6841).

The block diagram shows the relationship and function mode of the various monitoring functions and limitations in the inverter.

Signal flow



Links: Motor overload monitoring (I2×t)
Module overload monitoring (I×t)

[6-22] Signal flow for inverter

Description of the parameters

0x2901 | 0x3101 - Inverter A/B

Sub.	Name	Default setting	Data type
▸ 0x01	itc config	0x00DF	UNSIGNED16
▸ 0x02	option config	0x0000	UNSIGNED16
▸ 0x03	warning temperature	95 °C	INT16
▸ 0x07	switching frequency	1	UNSIGNED16
▸ 0x12	ixt limitation threshold	0	INT32
▸ 0x14	ixt warning threshold	0	INT32
▸ 0x16	limitation temperature	0 °C	INT16

Subindex 0x01: itc config

Configuration for inverter test (bit value 1 = execute test):
Bit 0: Initialisation of time stamp
Bit 1: Calibration of current offset for U/V/W phases
Bit 2: Check for valid DC-bus voltage
Bit 3: Loading of the bootstrap capacitor
Bit 4: Calibration of resolver phase and offset
Bit 5: Calibration of resolver amplitude
Bit 6: Motor connection test (danger of damage to device if deactivated)
Bit 7: motor earth fault detection test (danger of damage to device if deactivated) Bit 15: reserved

Scaling factor	Setting range	Default setting	Data type
1	0x0000 ... 0x00FF	0x00DF	UNSIGNED16

Subindex 0x02: Option config

MOBILE DCU
Configuration (bit value 0 = no, 1 = yes):
Bit 0: Trigger error if another inverter reports an error.
Bit 1 ... 2: Control of other inverter:
- 0: Use separate inverter output
- 1: Use the outputs of the velocity controller and DC link controller of the other inverter (2 x 3-phase control)
- 2: Use the outputs of the modulator of the other inverter (6-phase control)
- 3: Reserved

Bit 3: Invert the switching direction of the inverter's pulse width modulation signals
Bit 4: motor earth fault detection test (danger of damage to device if deactivated) Bit 15: reserved

MOBILE DCU PSU
Configuration (bit value 0 = no, 1 = yes):
Bit 0: Trigger error if another inverter reports an error.
Bit 1: motor earth fault detection test (danger of damage to device if deactivated) Bit 2: reserved
Bit 3: Invert the switching direction of the inverter's pulse width modulation signals
Bit 4: motor earth fault detection test (danger of damage to device if deactivated) Bit 15: reserved

MOBILE DCU S
Configuration (bit value 0 = no, 1 = yes):
Bit 0: motor earth fault detection test (danger of damage to device if deactivated) Bit 2: reserved
Bit 3: Invert the switching direction of the inverter's pulse width modulation signals
Bit 4: motor earth fault detection test (danger of damage to device if deactivated) Bit 15: reserved

Scaling factor	Setting range	Default setting	Data type
1	0x0000 ... 0x000F	0x0000	UNSIGNED16

Subindex 0x03: **Warning temperature**			
Warning threshold for temperature monitoring of the power section • If the threshold set here is reached, the warning bit 5 is set in the MC status word 1. • The warning threshold has a hysteresis of 5 °C.			
Scaling factor	Setting range	Default setting	Data type
6.250000000000E-002	0 ... 150 °C	95 °C	INT16

Subindex 0x07: **Switching frequency**			
Switching frequency of the inverter: 0 = 16 kHz, auto ("auto" = Adaptation of the switching frequency as a function of current and stator frequency) 1 = 8 kHz, auto 2 = 4 kHz, auto 3 = 16 kHz, permanent 4 = 8 kHz, permanent 5 = 4 kHz, permanent 6 = 2 kHz, permanent 7 = 16 kHz, fixed, VAC (for the “Power socket” application - with a higher continuous current but lower overload capacity)			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 7	1	UNSIGNED16

Subindex 0x12: **ixt limitation threshold**			
Threshold to limit the ixt-utilisation of the power section • The output current is reduced to 0 as of the threshold up to the maximum value. • Limitation is deactivated if the value is 0.			
Scaling factor	Setting range	Default setting	Data type
2.980232238770E-008	0 ... 1.964999	0	INT32

Subindex 0x14: **ixt warning threshold**			
Warning threshold for ixt-utilisation of the power section. • Warning is deactivated if the value is 0.			
Scaling factor	Setting range	Default setting	Data type
1.862645149231E-009	0 ... 2.000000	0	INT32

Subindex 0x16: **limitation temperature**			
Limitation of the power section’s temperature • The output current is reduced to 0 as of the threshold up to the maximum value. • Limitation is deactivated if the value is 0.			
Scaling factor	Setting range	Default setting	Data type
6.250000000000E-002	0 ... 150 °C	0 °C	INT16

0x2910 | 0x3110 - Motor A/B

Sub.	Name	Default setting	Data type
▸ 0x03	temperature warning limit	75 °C	INT16
▸ 0x04	temperature error limit	85 °C	INT16
▸ 0x09	temperature limitation limit	0 °C	INT16

Subindex 0x03: Temperature warning limit

Warning threshold for temperature monitoring of the motor
- If the threshold set here is reached, the warning bit 15 is set in the MC status word 1.
- The warning threshold has a hysteresis of 5 °C.

Scaling factor	Setting range	Default setting	Data type
6.250000000000E-002	0 ... 350 °C	75 °C	INT16

Subindex 0x04: Temperature error limit

Error threshold for temperature monitoring of the motor
- If the threshold set here is reached, the error bit 16 is set in the MC status word 1.
- The error threshold has a hysteresis of 5 °C.

Scaling factor	Setting range	Default setting	Data type
6.250000000000E-002	0 ... 350 °C	85 °C	INT16

Subindex 0x09: temperature limitation limit

Threshold for motor temperature limitation
- The output current is reduced to 0 as of the threshold up to the maximum value.
- Limitation is deactivated if the value is 0.

Scaling factor	Setting range	Default setting	Data type
6.250000000000E-002	0 ... 350 °C	0 °C	INT16

0x2980 | 0x3180 - Motor A/B I2xt Load

Sub.	Name	Default setting	Data type
▸ 0x07	threshold warning	0	REAL32
▸ 0x08	threshold fault	0	REAL32
▸ 0x0A	threshold limitation	0	REAL32

Subindex 0x07: threshold warning

Warning threshold for monitoring the motor utilisation
- If the threshold set here is reached, the warning bit 3 is set in the MC status word 2.
- If the setting is "0", monitoring is deactivated and no warning is output.

Scaling factor	Setting range	Default setting	Data type
1	0 ... 2	0	REAL32

Subindex 0x08: threshold fault

Error threshold for monitoring the motor utilisation
- If the threshold set here is reached, the error bit 2 is set in the MC status word 4.
- If the setting is "0", monitoring is deactivated and no error is output.

Scaling factor	Setting range	Default setting	Data type
1	0 ... 2	0	REAL32

Subindex 0x0A: threshold limitation

Threshold of the thermal motor load limitation (the recommended value is 0.8)
- The output current is reduced to 0 as of the threshold up to the error threshold.
- If the setting is "0", limitation is deactivated.

Scaling factor	Setting range	Default setting	Data type
1	0 ... 2	0	REAL32

6.21 Motor overload monitoring (I2×t)

Objects described in this chapter and their availability for the MOBILE devices:

Object	Name	MOBILE			
		DCU	PSU	DCU PSU	DCU S
0x2980	Motor I2×t Load INV A	●			●
0x3180	Motor I2×t Load INV B	●		●	

This monitoring function prevents thermal overload of the motor by calculating the thermal motor utilisation from the measured motor currents on the basis of a mathematical model and, in the case of continuous overload, interrupting further operation.

Stop!

Monitoring the motor utilisation (I^2xt) is not a means for full motor protection!

Since the motor utilisation calculated in the thermal model gets lost after mains switching, the following operating states cannot be determined correctly:

- Restarting (after mains switching) of a motor that is already very hot.
- Change of the cooling conditions (e.g. cooling air flow interrupted or too warm).

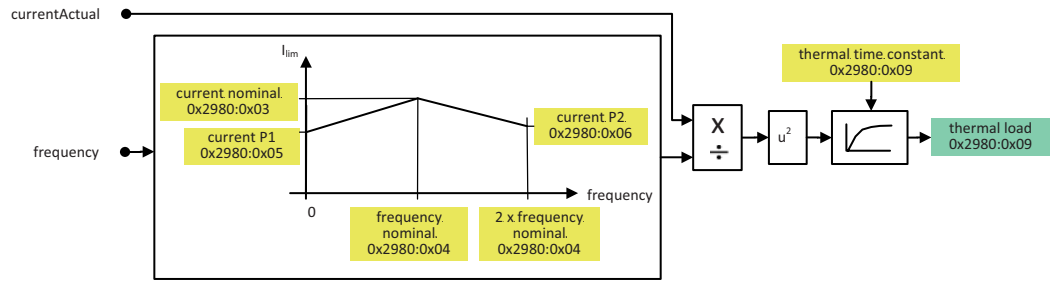
Full motor protection requires additional measures such as the evaluation of temperature sensors that are located directly in the winding or the use of thermal contacts.

Basically, the model comprises the copper losses in the stator which rise quadratically with the current at a constant copper resistance. The reference magnitude is the thermal maximum current of the motor which allows the motor to be subjected to a constant load with a given cooling. For defining this value, the maximum possible ambient temperature has to be considered.

In many applications, the cooling of the motor depends on the speed, either by cooling with self-ventilation or by airstream.

- The two reference points I_{P1} and I_{P2} enable the simulation of a speed-dependent cooling.
- If the cooling is independent of the speed, as e.g. in case of water cooling, the two currents I_{P1} and I_{P2} have to be set identically with the rated motor current I_{rated}.

Signal flow



[6-23] Signal flow for motor overload monitoring (I2×t)

Description of the parameters

0x2980 | 0x3180 - Motor A/B I2xt Load

Sub.	Name	Default setting	Data type
▸ 0x02	thermal time constant	60 s	REAL32
▸ 0x03	current nominal	82 A	REAL32
▸ 0x04	frequency nominal	50 Hz	REAL32
▸ 0x05	current P1	82 A	REAL32
▸ 0x06	current P2	82 A	REAL32

Thermal time constant of the motor			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 900.0 s	60 s	REAL32

Subindex 0x03: **current nominal**			
Rated motor current I_N			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 300 A	82 A	REAL32

Subindex 0x04: **frequency nominal**			
Rated motor frequency f_N			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 2000 Hz	50 Hz	REAL32

Subindex 0x05: **current P1**			
Stator current I_{P1} (at stator frequency = 0 Hz)			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 300 A	82 A	REAL32

Subindex 0x06: **current P2**			
Stator current I_{P2} (at twice the rated motor frequency f_N)			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 300 A	82 A	REAL32

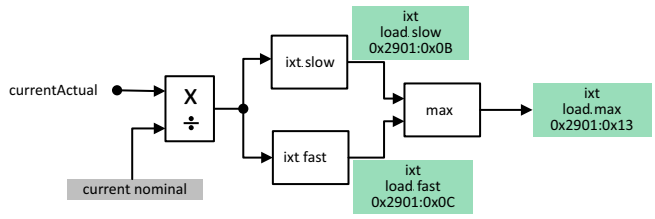
6.22 Module overload monitoring (I×t)

Objects described in this chapter and their availability for the MOBILE devices:

Object	Name	MOBILE			
		DCU	PSU	DCU PSU	DCU S
	Module overload monitoring (I×t) INV A	●			●
	Module overload monitoring (I×t) INV B	●		●	

The I×t-monitoring protects the 6 half-bridges of the power section. This monitoring cannot be parameterised. The behaviour can be influenced by the choice of switching frequency.

Signal flow



[6-24] Signal flow for module overload monitoring (I×t)

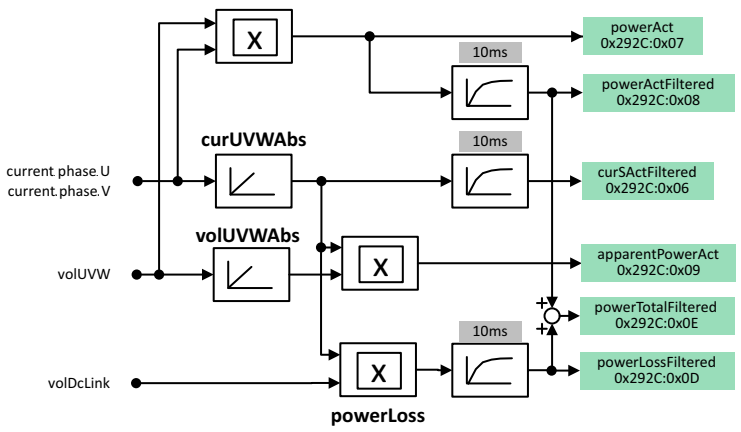
6.23 Power calculation

Objects described in this chapter and their availability for the MOBILE devices:

Object	Name	MOBILE			
		DCU	PSU	DCU PSU	DCU S
	Power calculation INV A	●			●
	Power calculation INV B	●		●	

The power calculation function block calculates the active and apparent power as well as the stator voltage and stator current.

Signal flow



[6-25] Signal flow for power calculation

6.24 Configuring the on-board converter

Objects described in this chapter and their availability for the MOBILE devices:

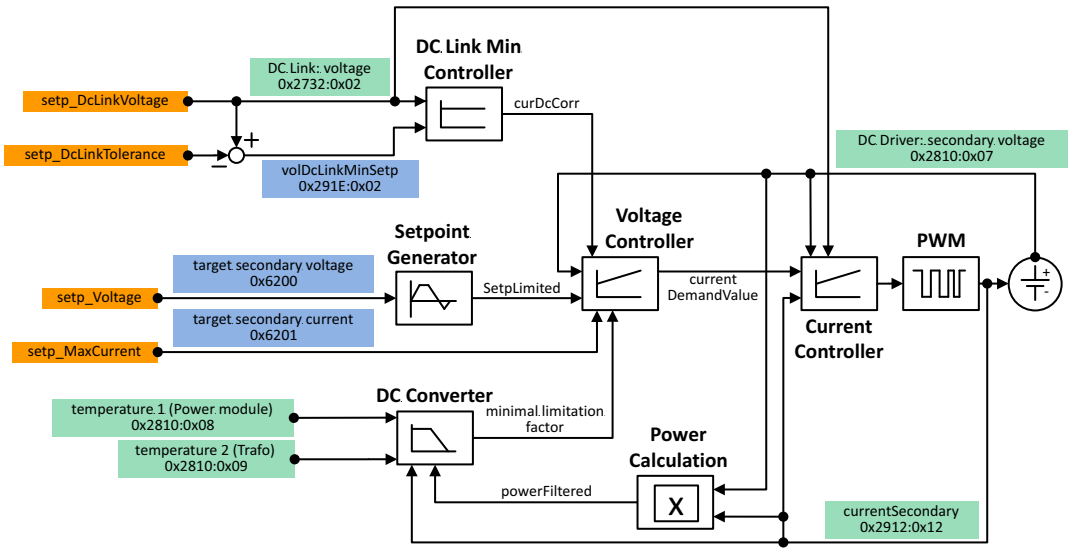
Object	Name	MOBILE			
		DCU	PSU	DCU PSU	DCU S
0x2900	DC Converter Supervision		●	●	
0x2901	DC Converter		●	●	
0x2912	DC Controller Current Controller		●	●	
0x2918	DC Controller Setpoint Generator		●	●	
0x291A	DC Controller Voltage Controller		●	●	
0x291E	DC Controller DC Link Min Controller		●	●	

The on-board converter converts the DC-bus voltage into the on-board voltage. If the load requires more current than the on-board converter can supply (setp_MaxCurrent), the specified on-board voltage (setp_Voltage) will not be reached. It is then regulated to the specified current (setp_MaxCurrent). The controller is a cascaded voltage-current controller.

The on-board converter can reduce the current with the "DC link min controller" if the minimum DC link voltage is reached.

The power section is protected by temperature- and i×t-monitoring.

Signal flow



Links:

DC Link Min Controller: DC link minimum controller	Setpoint Generator: Setpoint generator	DC Converter: Onboard converters
Voltage Controller: Voltage controller	Current Controller: Current controller	Power Calculation: Power calculation

[6-26] Overview of signal flow for on-board converter (simplified representation)

Input variables via Public CAN

Name	Info	Further information
setp_DcLinkVoltage	Setpoint for DC-bus voltage	▸ Status of the master control
setp_DcLinkTolerance	This value is subtracted from the *setp_DcLinkVoltage* setpoint in order to obtain the minimum value of the DC-bus voltage required for derating. If not used, the value 0 has to be sent.	▸ Setpoints for onboard converter
setp_Voltage	Voltage setpoint for DC/DC converter	
setp_MaxCurrent	Maximum output current for DC/DC converter In slave mode (several DC/DC converters in parallel), this value is set to the actual current value of the DC/DC master.	

6.24.1 Response to communication error

This parameter defines the response to a communication error.

0x2900 - DC Converter Supervision

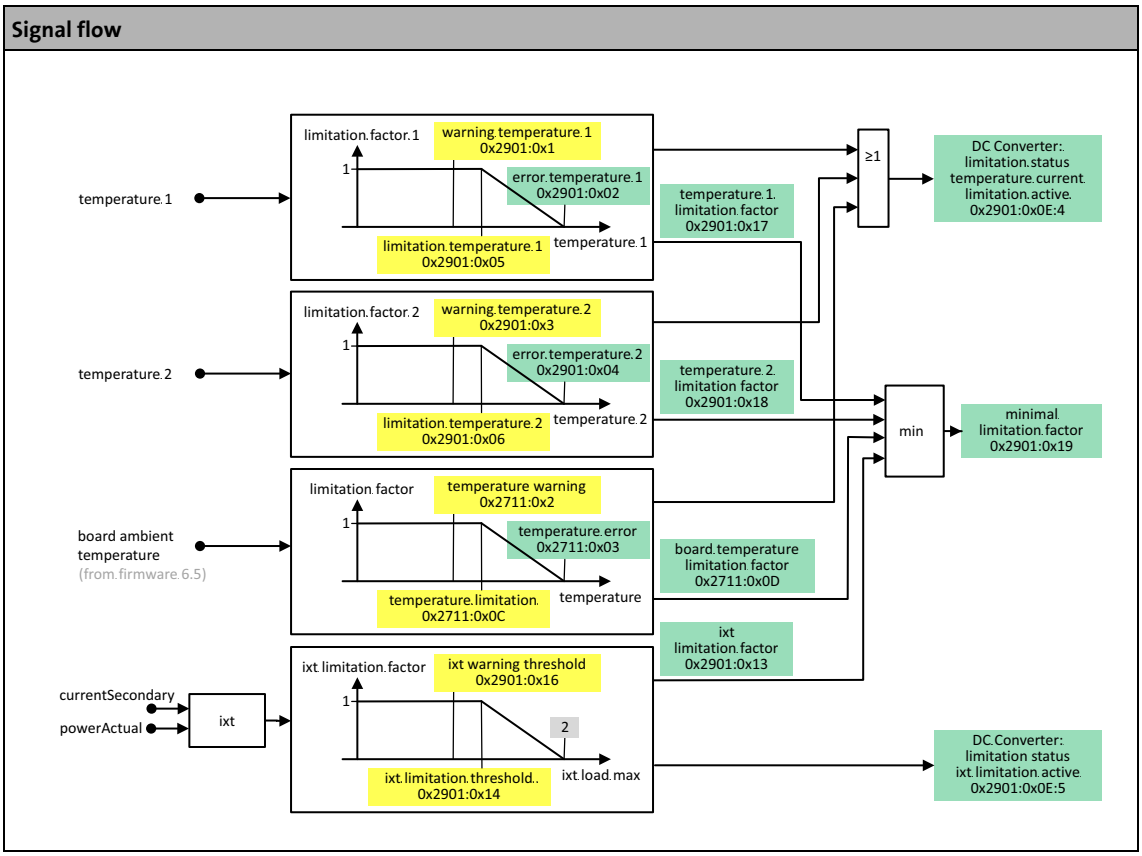
Subindex 0x09: **communication fault reaction**			
Response to communication errors: 0 = no error response 1 = Warning 2 = --- (reserved) 3 = --- (reserved) 4 = --- (reserved) 5 = error			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 5	5	UNSIGNED16

6.24.2 Onboard converters

The on-board converter is protected by the measured temperatures of the power section and the transformer as well as the i×t-monitoring. The output current is reduced to 0 as of the set threshold (limitation) up to the maximum value.

If the output power is above the rated power on account of a high output voltage, the output current is limited by the i×t-limitation. ▸ Module overload monitoring (I×t) (📖 168)

Signal flow



[6-27] Signal flow for on-board converter (simplified representation)

Description of the parameters

0x2901 - DC Converter

Sub.	Name	Default setting	Data type
▸ 0x01	warning temperature 1 (for the power section)	100 °C	INT16
▸ 0x02	error temperature 1 (for the power section)	110 °C	INT16
▸ 0x03	warning temperature 2 (for the transformer core)	110 °C	INT16
▸ 0x04	error temperature 2 (for the transformer core)	120 °C	INT16
▸ 0x05	limitation temperature 1 (for the power section)	100 °C	INT16
▸ 0x06	limitation temperature 2 (for the transformer core)	110 °C	INT16
▸ 0x07	voltageSecondaryMin	2 V	INT32
▸ 0x08	errorTimeMax	1.999872 s	INT16
▸ 0x14	ixt limitation threshold	1.949999	INT32
▸ 0x16	ixt warning threshold	0	INT32

Subindex 0x01: warning temperature 1

Warning threshold for the power section
- If the threshold set here is reached, the warning bit 5 is set in the MC status word 1.
- The warning threshold has a hysteresis of 5 °C.

Scaling factor	Setting range	Default setting	Data type
6.250000000000E-002	-20 ... 150 °C	100 °C	INT16

Subindex 0x02: error temperature 1

Error threshold for the power section
- Read only
- If the threshold set here is reached, the error bit 1 is set in the MC status word 6.
- The warning threshold has a hysteresis of 5 °C.

Scaling factor	Setting range	Default setting	Data type
6.250000000000E-002		110 °C	INT16

Subindex 0x03: warning temperature 2

Warning threshold for the transformer core
- If the threshold set here is reached, the warning bit 8 is set in the MC status word 1.
- The warning threshold has a hysteresis of 5 °C.

Scaling factor	Setting range	Default setting	Data type
6.250000000000E-002	-20 ... 150 °C	110 °C	INT16

Subindex 0x04: error temperature 2

Error threshold for the transformer core
- Read only
- If the threshold set here is reached, the error bit 1 is set in the MC status word 9.
- The warning threshold has a hysteresis of 5 °C.

Scaling factor	Setting range	Default setting	Data type
6.250000000000E-002		120 °C	INT16

Subindex 0x05: **limitation temperature 1**			
Temperature limitation for the power section. • Limitation is deactivated if the value is 0.			
Scaling factor	Setting range	Default setting	Data type
6.250000000000E-002	-2048 ... 2047.9375 °C	100 °C	INT16

Subindex 0x06: **limitation temperature 2**			
Temperature limitation for the transformer core. • Limitation is deactivated if the value is 0.			
Scaling factor	Setting range	Default setting	Data type
6.250000000000E-002	-2048 ... 2047.9375 °C	110 °C	INT16

Subindex 0x07: **voltageSecondaryMin**			
Voltage threshold for monitoring for too low output voltage • If the output voltage is lower than the voltage threshold set here for longer than the duration set in subindex 0x08 (errorTimeMax), error bit 10 is set in the MC status word 1. • If the setting is "0", monitoring is deactivated.			
Scaling factor	Setting range	Default setting	Data type
2.441406250000E-004	0 ... 40 V	2 V	INT32

Subindex 0x08: **errorTimeMax**			
Time period for monitoring for too low output voltage • See subindex 0x07.			
Scaling factor	Setting range	Default setting	Data type
1.024000000000E-003	0 ... 33.553408 s	1.999872 s	INT16

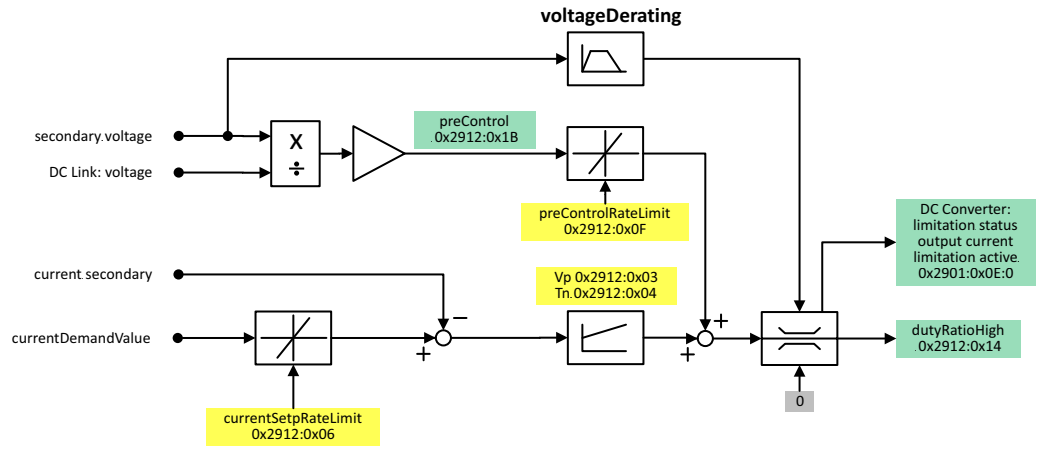
Subindex 0x14: **ixt limitation threshold**			
The limitation factor is reduced to 0 as of the threshold up to the maximum value. • Limitation is deactivated if the value is 0.			
Scaling factor	Setting range	Default setting	Data type
2.980232238770E-008	0 ... 1.964999	1.949999	INT32

Subindex 0x16: **ixt warning threshold**			
Warning threshold for ixt-utilisation of the power section. • Warning is deactivated if the value is 0.			
Scaling factor	Setting range	Default setting	Data type
1.862645149231E-009	0 ... 2.000000	0	INT32

6.24.3 Current controller

The current controller regulates the current current to the setpoint. The ratio between output voltage and DC-bus voltage is used for the feedforward control. The current controller's output is limited in the case of a very low or very high output voltage.

Signal flow



Links: voltageDerating: Voltage derating

[6-28] Signal flow for current controller (simplified representation)

Description of the parameters

0x2912 - DC Controller Current Controller

Sub.	Name	Default setting	Data type
▸ 0x03	Vp	0.0005 1/A	REAL32
▸ 0x04	Tn	0.0002 s	REAL32
▸ 0x06	currentSetpRateLimit	100000 A/s	REAL32
▸ 0x0D	currentPrimaryOffset	0 A	REAL32
▸ 0x0F	preControlRateLimit	200 1/s	REAL32

Subindex 0x03: **Vp**			
Current controller: Gain Vp			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 0.2 1/A	0.0005 1/A	REAL32

Subindex 0x04: **Tn**			
Current controller: Reset time Tn			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 0.01 s	0.0002 s	REAL32

Subindex 0x06: **currentSetpRateLimit**			
Current controller: Maximum rate of rise of the current setpoint			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 1000000 A/s	100000 A/s	REAL32

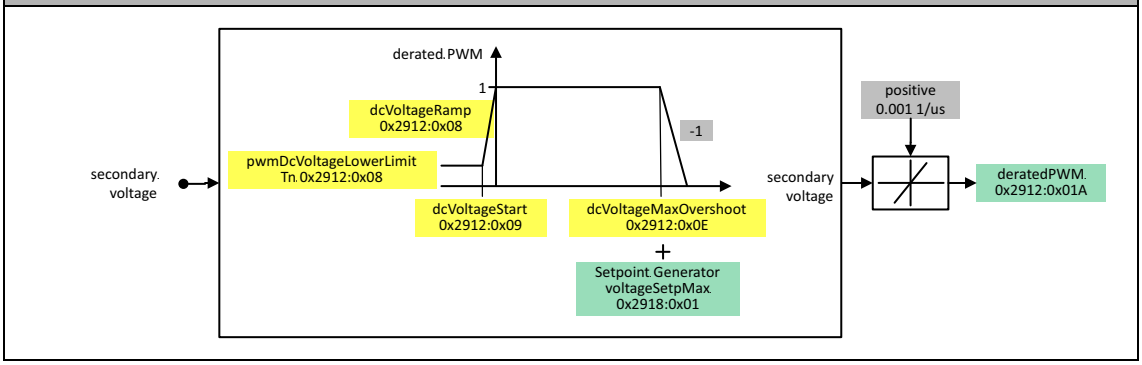
Subindex 0x0D: **currentPrimaryOffset**			
Current offset to correct the secondary current • The measured primary current is multiplied by this offset value to calculate the secondary current for the controller.			
Scaling factor	Setting range	Default setting	Data type
1	-2 ... 2 A	0 A	REAL32

Subindex 0x0F: **preControlRateLimit**			
Rise limitation of the voltage feedforward control for the current controller			
Scaling factor	Setting range	Default setting	Data type
1	1 ... 1000 1/s	200 1/s	REAL32

6.24.4 Voltage derating

The current controller's output is limited in the case of a very small and very large output voltage. The reference points for this limitation are parameterisable.

Signal flow



[6-29] Signal flow for voltage derating (simplified representation)

Description of the parameters

0x2912 - DC Controller Current Controller

Sub.	Name	Default setting	Data type
▸ 0x08	dcVoltageRamp	1 1/V	REAL32
▸ 0x09	dcVoltageStart	-1 V	REAL32
▸ 0x0A	pwmDcVoltageLowerLimit	0.03	REAL32
▸ 0x0E	dcVoltageMaxOvershoot	1.0 V	REAL32

Subindex 0x08: **dcVoltageRamp**			
PWM derating for low DC output voltage • Derating = dcVoltageRamp x (current DC output voltage - dcVoltageStart)			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 10 1/V	1 1/V	REAL32

Subindex 0x09: **dcVoltageStart**			
PWM derating for low DC output voltage • Derating = dcVoltageRamp x (current DC output voltage - dcVoltageStart)			
Scaling factor	Setting range	Default setting	Data type
1	-10 ... 10 V	-1 V	REAL32

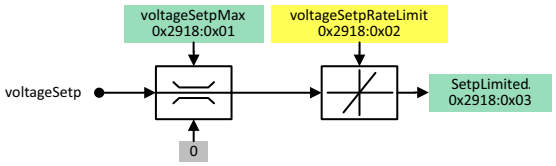
Subindex 0x0A: **pwmDcVoltageLowerLimit**			
Lower limit for PWM derating in the case of a low DC output voltage			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 0.2	0.03	REAL32

Subindex 0x0E: **dcVoltageMaxOvershoot**			
Maximally permitted overshoot value of the DC voltage			
Scaling factor	Setting range	Default setting	Data type
1	-24.0 ... 3.0 V	1.0 V	REAL32

6.24.5 Setpoint generator

The setpoint is limited to the maximum value and changed with an adjustable ramp.

Signal flow



[6-30] Signal flow for setpoint generator (simplified representation)

Description of the parameters

0x2918 - DC Controller Setpoint Generator

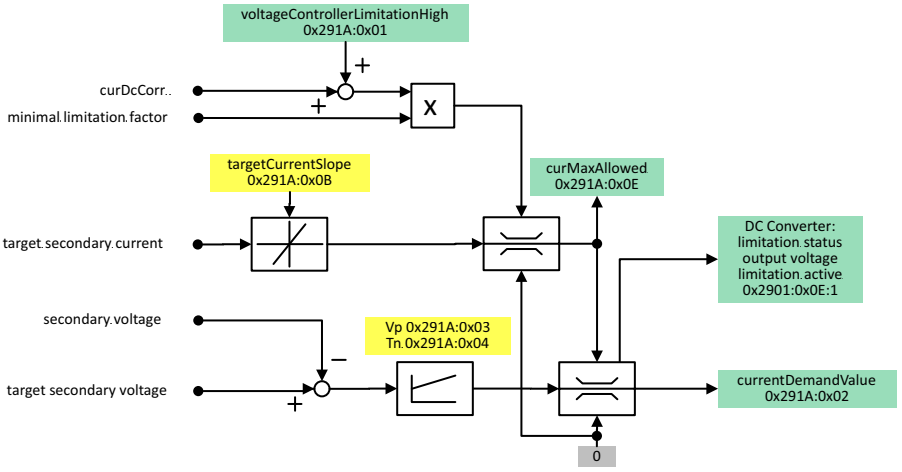
Subindex 0x01: **voltageSetpMax**			
Voltage setpoint limitation • Read only			
Scaling factor	Setting range	Default setting	Data type
1		P, T: [16]; U, V, S, C: [32] V	REAL32

Subindex 0x02: **voltageSetpRateLimit**			
Maximum rate of rise of the voltage setpoint			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 100000 V/s	2500 V/s	REAL32

6.24.6 Voltage controller

The voltage controller regulates the current voltage to the required value. The voltage controller's output is the current setpoint (currentDemandValue). The required current (target secondary current) and the limited maximum value limit the current controller's output.

Signal flow



[6-31] Signal flow for voltage controller (simplified representation)

Description of the parameters

0x291A - DC Controller Voltage Controller

Sub.	Name	Default setting	Data type
▸ 0x01	voltageControllerLimitationHigh	562, U, V, S, C: 282, P, T: [200] A 282, U, V, S, C: [100] A	REAL32
▸ 0x03	Vp	3 A/V	REAL32
▸ 0x04	Tn	0.003 s	REAL32
▸ 0x0B	targetCurrentSlope	100 A/s	REAL32
▸ 0x0F	voltageControllerAdaption	0.01	REAL32

Subindex 0x01: **voltageControllerLimitationHigh**			
Upper limitation of the voltage controller • Read only			
Scaling factor	Setting range	Default setting	Data type
1		562, U, V, S, C: 282, P, T: [200] A 282, U, V, S, C: [100] A	REAL32

Subindex 0x03: **Vp**			
Voltage controller: Gain Vp • The controller is designed as a PI controller.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 20 A/V	3 A/V	REAL32

Subindex 0x04: **Tn**			
Voltage controller: Reset time Tn • The controller is designed as a PI controller.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 1 s	0.003 s	REAL32

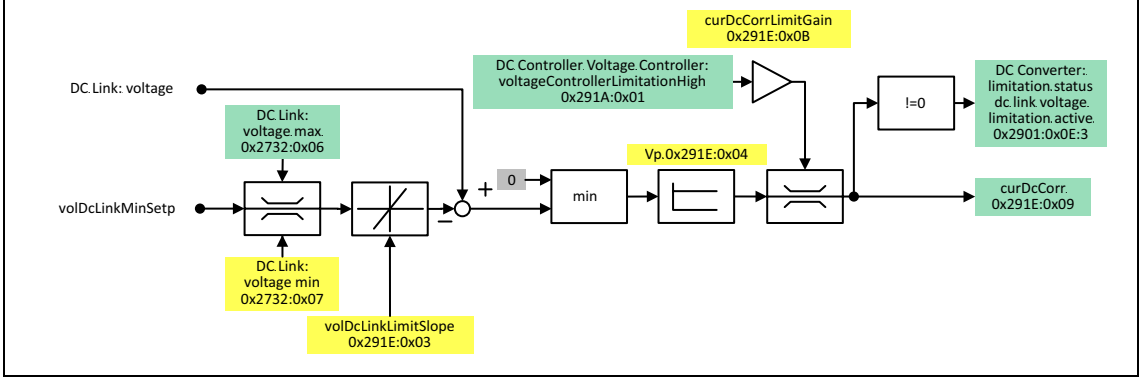
Subindex 0x0B: **targetCurrentSlope**			
Voltage controller: rate of rise of the setpoint current			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 1000000 A/s	100 A/s	REAL32

Subindex 0x0F: **voltageControllerAdaption**			
Voltage controller: adaption ki • ki = Vp/Tn x current secondary current x voltageControllerAdaption			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 0.1	0.01	REAL32

6.24.7 DC link minimum controller

Der DC bus controller tries to keep the DC bus voltage within the required range. If the DC bus voltage falls below the minimum required value, the maximum current is reduced via the current correction (curDcCorr). This reduces the load on the DC bus.

Signal flow



[6-32] Signal flow for DC link minimum controller (simplified representation)

Description of the parameters

0x291E - DC Controller DC Link Min Controller

Sub.	Name	Default setting	Data type
▸ 0x03	volDcLinkLimitSlope	10 V/s	REAL32
▸ 0x04	dcLinkController Vp	2 A/V	REAL32
▸ 0x0B	curDcCorrLimitGain	1	REAL32

Subindex 0x03: **volDcLinkLimitSlope**			
Ramp for the maximum change of the DC-bus voltage limits • If the setting is "0", no ramp limitation is active and the DC-bus voltage limits directly follow the setpoint.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 100000 V/s	10 V/s	REAL32

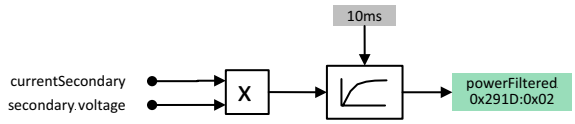
Subindex 0x04: **dcLinkController Vp**			
DC-bus controller: Gain Vp • The controller is designed as P controller with deadband. • Depending on the setpoints for the maximum and minimum DC-bus voltage, the controller calculates a correction current. The control responds to this correction current such that the DC-bus voltage moves towards the permitted area.			
Scaling factor	Setting range	Default setting	Data type
1	0 ... 1000 A/V	2 A/V	REAL32

Subindex 0x0B: **curDcCorrLimitGain**			
DC-bus minimum controller: gain to correct the current limit			
Scaling factor	Setting range	Default setting	Data type
1	0.1 ... 1	1	REAL32

6.24.8 Power calculation

The output power is calculated and filtered with the output voltage and output current.

Signal flow



[6-33] Signal flow for power calculation (simplified representation)

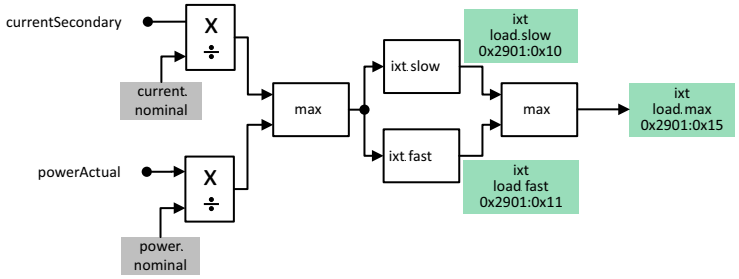
6.24.9 Module overload monitoring (I×t)

Objects described in this chapter and their availability for the MOBILE devices:

Object	Name	MOBILE			
		DCU	PSU	DCU PSU	DCU S
	Module overload monitoring (I×t) PSU		●	●	

The I×t-monitoring protects the half-bridges of the power section. This monitoring cannot be parameterised.

Signal flow



[6-34] Signal flow for module overload monitoring (I×t) (simplified representation)

7 Public CAN

The "Public CAN" customer interface is used for communication with the vehicle or subsystem control (e.g. air conditioning system) according to SAE J1939.

7.1 Data format of the physical values

Data types

Data type	Abbreviation	Length
Unsigned Char	UC	8 bits
Unsigned Short	US	16 bits
Unsigned Long	UL	32 bits

Scaling

Parameter (signal)	Scaling (name)	Resolution (1 bit)	Physical value range	Offset	Data type	J1939 slot (J1939-71)
Current	scCur1	0.05 A	-1600 ... 1612.75 A	-1600 A	US	SAEec01
Voltage	scVolt1	0.2 V	0 ... 50 V	0	UC	-
Voltage (as of version 05.4)	scVolt1	0.001 V	0 ... 64,255 V	0	US	SAEev06
Voltage	scVolt2	4 V	0 ... 1000 V	0	UC	-
Performance	scPower1	0.005 kW	-160 ... 161.275 kW	-160 KW	US	-
Torque	scTorque1	0.2 Nm	-6400 ... 6451 Nm	-6400 Nm	US	-
Speed	scVeloc1	1 rpm	-32000 ... 32255 rpm	-32000 rpm	US	-
Temperature	scTemp1	1 °C	-40 ... 210 °C	-40°C	UC	SAEtp01
Percent	scPercent	1 %	0 ... 250 %	0	UC	-

Conversion formulae

- CAN data word = (physical value - offset) / scaling
- Physical value = (CAN data word * scaling) + offset

Value ranges

Each value range for a certain data type is divided in several sub-ranges with a different meaning (in compliance with SAE J1939-71). Thus, additional information can also be placed in the data word. As, however, not the entire value range of a data type can be used for transferring the physical value, appropriate scalings are required.

1-byte values		
Meaning	Value range (hexadecimal)	Value range (decimal)
Valid	00 ... FA	0 ... 250
Initialization	FB	251
Reserved	FC ... FD	252 ... 253
Error message	FE	254
Code for "signal not available"	FF	255

2-byte values		
Meaning	Value range (hexadecimal)	Value range (decimal)
Valid	0000 ... FAFF	0 ... 64255
Initialization	FB00 ... FBFF	64256 ... 64511
Reserved	FC00 ... FDFF	64512 ... 65023
Error message	FE00 ... FEFF	65024 ... 65279
Code for "signal not available"	FF00 ... FFFF	65280 ... 65535

4-byte values		
Meaning	Value range (hexadecimal)	Value range (decimal)
Valid	00000000 ... FAFFFFFF	0 ... 4211081215
Initialization	FB000000 ... FBFFFFFF	4211081216 ... 4227858431
Reserved	FC000000 ... FDFFFFFF	4227858432 ... 4261412863
Error message	FE000000 ... FEFFFFFF	4261412864 ... 4278190079
Code for "signal not available"	FF000000 ... FFFFFFFF	4278190080... 4294967294

Binary 2-bit status signals		
Meaning	Value (binary)	Value (decimal)
Inactive (off, passive, closed, etc.)	00	0
Active (on, active, etc.)	01	1
Error message	10	2
Code for "signal not available"	11	3

Binary 2-bit control signals		
Meaning	Value (binary)	Value (decimal)
Deactivating (switch off, inhibit, etc.)	00	0
Activating (switch on, enable, etc.)	01	1
Reserved	10	2
No data (signal has no effect)	11	3

7.2 Parameter groups (PGs)

In compliance with network protocol J1939, the parameters (signals) are summarised in parameter groups (PGs).

- The parameter groups of the MOBILE do not have a permanent data length of 8 bytes.
- Non-required data bytes have the value 0xFF ("signal not available").
- The parameters (signals) are transmitted in the "little-endian format" (also "Intel format"), i.e. the byte with the least-significant bits comes first.

7.2.1 Identifier

29 bits are used for the identifier of a parameter group. The identifier contains the information whether the message is directed to all nodes ("broadcast") or to one certain node only ("Peer-to-Peer").

Bit 28 (msb) ... bit 26	Bit 25	Bit 24	Bit 23 ... bit 16	Bit 15 ... bit 8	Bit 7 ... bit 0 (lsb)
Priority	Extended Data Page	Data Page	PDU Format	PDU Specific	Source Address (SA)
0 ... 7	0 for J1939	0 or 1 for J1939	see below	see below	0 ... 253 (transmitter address)

Priority:	0 … highest priority; 7… lowest priority
PDU format:	0 ... 239 … "Peer-to-Peer" message (239 for manufacturer-specific messages) 240 ... 255 … "broadcast" message (255 for manufacturer-specific messages)
PDU specific:	For "Peer-to-Peer" message: Recipient address In case of "broadcast" message: Group extension (e.g. 0x01 for inverter-1 signals)

7.2.2 Parameter Group Number (PGN)

Each parameter group can be identified by an unambiguous number, the "Parameter Group Number" (PGN). The PGN has a data length of 24 bits. The structure of the PGN depends on whether is it a "Peer-to-Peer" or "broadcast" message.

Structure of a "Peer-to-Peer" PGN

- The PGN corresponds to the Identifier without "Priority" and "Source Address".
- "PDU Specific" is set to the value "0".
- The front 6 bits (bit 18 ... bit 23) are filled with zeros.

Bit 23 (msb) ... bit 18	Bit 17	Bit 16	Bit 15 ... bit 8	Bit 7 ... bit 0
-	Extended Data Page	Data Page	PDU Format	PDU Specific
0	0	0	0 ... 239	0
Example: 0x00ED00 PDU format = 0xED = 237 = "Peer-to-Peer" message				

Structure of a "broadcast" PGN

- The PGN corresponds to the Identifier without "Priority" and "Source Address".
- The front 6 bits (bit 18 ... bit 23) are filled with zeros.

Bit 23 (msb) ... bit 18	Bit 17	Bit 16	Bit 15 ... bit 8	Bit 7 ... bit 0
-	Extended Data Page	Data Page	PDU Format	PDU Specific
0	0	0	240 ... 255	Group extension
Example: 0x00FE01 PDU specific = 0x01 = 1 = group extension (here for inverter-1signals) PDU format = 0xFE = 140 = "broadcast" message				

Note!

For the MOBILE, only "broadcast" are to be used!

The reason for this is that only two "Peer-to-Peer" PGNs for manufacturer-specific messages exist ("PDU format" = 239 with "Data Page" = 0 or 1). The other possible settings for "PDU format" are assigned to J1939-PGs and thus not available for the MOBILE.

In order to address a certain device in a network of several MOBILEs, the "broadcast" PGN has to contain the device number (1 ... 14) of the corresponding MOBILE. For this purpose, the bits 4 ... 7 of the group extension are used in the default setting.

Examples:

- Group extension = 0x**1**1 → message 1 for MOBILE **1**
- Group extension = 0x**2**1 → message 1 for MOBILE **2**
- Group extension = 0x**3**1 → message 1 for MOBILE **3**
- etc.

7.3 Public CAN receive messages

Overview

The following table shows all receive messages.

- The Identifier are based on the default setting of the MOBILE:
  - CAN address of the MOBILE = 234 (0xEA)
  - Device number = 1 (MOBILE 1)
- CAN address of the master control = 128 (0x80)
- The cycle time is preset for messages to 100 ms.

CAN-ID		MOBILE				Name	Detailed description
[decimal]	[hex]	DCU	PSU	DCU/ DCU	DCU/ PSU		
Prio: 6 PGN: 65296 SA: 128	0x18FF1080	R	R	R	R	Receive message 0 (broadcast)	▸ Status of the master control
Prio: 6 PGN: 65297 SA: 128	0x18FF1180	R	-	R	-	Receive message 1	▸ Setpoints for motor A
Prio: 6 PGN: 65298 SA: 128	0x18FF1280	-	-	R	R	Receive message 2	▸ Setpoints for motor B
Prio: 6 PGN: 65299 SA: 128	0x18FF1380	-	R	-	R	Receive message 3	▸ Setpoints for onboard converter

Default values after timeout

The MOBILE monitors the continuous reception of the cyclic receive messages.

- For each receive message, a separate monitoring is executed.
- Monitoring gets active as soon as the corresponding receive message has been received for the first time by the master control.
- If a receive message remains off longer than the set timeout time, the corresponding parameters (signals) are set to default values for the MOBILE. The corresponding default values can be obtained from the detailed description of the receive messages.
- The timeout time is preset for all messages to 500 ms.

7.3.1 Status of the master control

CAN-ID		Cycle time	Timeout time	Transmitter	Receiver
0x18FF10yy	Prio: 6, PGN: 0xFF10, SA: yy	100 ms	500 ms	yy	All MOBILEs

Byte	Bit	Name	Value range (scaling)	Timeout value	Info
0	0 ... 1	SystemEnable	0 ... 3	last value	System enable (global enable of all connected MOBILEs): 0: No enable 1: Enable 2: Reserved 3: no data
	2 ... 3	Clamp15_CAN	0 ... 3	3	Status of terminal 15: 0: No terminal-15 signal 1: Terminal-15 signal 2: Reserved 3: no data
	4 ... 5	DischargeEnable (As of firmware R6.4)	0 ... 3	last value	Command for activating the discharge process of one or several MOBILE units (depending on the configuration). 0: No enable 1: Enable 10: n.d. 11: N/A (behavior: No enable)
	6 ... 7	-	-	-	Reserved
1		setp_DcLinkVoltage	0 ... 1000 [V] (scVolt2)	last value or default value (dependent on 0x4040:0x05, 0x4050:0x05, 0x4060:0x05)	Setpoint for DC-bus voltage. If not used, the value 0 has to be send.
2		-	-	-	Reserved
3		setp_ VoltagePrechargeDemand (As of firmware R6.3)	0 ... 1000 [V] (scVolt2)	last value or default value (dependent on 0x4040:0x05, 0x4050:0x05, 0x4060:0x05)	Setpoint for precharging the DC link. If 0x00 or >0xFA is transmitted, the parameter 0x4010:0x05 is used as a precharging setpoint. ▸ Precharge function (📖 89)
4 - 7		-	-	-	Reserved

7.3.2 Setpoints for motor A

CAN-ID		Cycle time	Timeout time	Transmitter	Receiver
0x18FF**z**1yy	Prio: 6, PGN: 0xFF**z**1, SA: yy	100 ms	500 ms	yy	MOBILE no. **z**
					z = address offset + 1 ▸ Device identification

Byte	Bit	Name	Value range (scaling)	Timeout value	Info
0	0 ... 1	ctrlDCU	0 ... 3	last value	Drive Control Unit (DCU): 0: Switch off DCU 1: Switch on DCU 2: Reserved 3: no data
	2 ... 7	-	-	-	Reserved
1		setp_DcLinkTolerance	0 ... 1000 [V] (scVolt2)	last value or default value (dependent on 0x4040:0x05)	This value is added to the setp_DcLinkVoltage setpoint or subtracted in order to obtain the maximum and minimum value of the DC-bus voltage required for derating. If not used, the value 0 has to be send.
2		setp_MotPower	0 ... 250 [%] (scPercent)	last value or default value (dependent on 0x4040:0x05)	Motor power limit for output INV A. If not used, the value 0 has to be send.
3		setp_GenPower	0 ... 250 [%] (scPercent)	last value or default value (dependent on 0x4040:0x05)	Generator power limit for output INV A. If not used, the value 0 has to be send.
4 - 5		setp_Speed	-32000 ... 32255 [rpm] (scVeloc1)	last value or default value (dependent on 0x4040:0x05)	Velocity mode: Speed setpoint for motor A Torque mode: Speed limit for speed limitation
6 - 7		setp_Torque	-6400 ... 6451 [Nm] (scTorque1)	last value or default value (dependent on 0x4040:0x05)	Torque mode: Torque setpoint for motor A

7.3.3 Setpoints for motor B

CAN-ID		Cycle time	Timeout time	Transmitter	Receiver
0x18FF**z**2yy	Prio: 6, PGN: 0xFF**z**2, SA: yy	100 ms	500 ms	yy	MOBILE no. **z**
					z = address offset + 1 ▸ Device identification

Byte	Bit	Name	Value range (scaling)	Timeout value	Info
0	0 ... 1	ctrlDCU	0 ... 3	last value	Drive Control Unit (DCU): 0: Switch off DCU 1: Switch on DCU 2: Reserved 3: no data
	2 ... 7	-	-	-	Reserved
1		setp_DcLinkTolerance	0 ... 1000 [V] (scVolt2)	last value or default value (dependent on 0x4050:0x05)	This value is added to the setp_DcLinkVoltage setpoint or subtracted in order to obtain the maximum and minimum value of the DC-bus voltage required for derating. If not used, the value 0 has to be send.
2		setp_MotPower	0 ... 250 [%] (scPercent)	last value or default value (dependent on 0x4040:0x05)	Motor power limit for output INV B. If not used, the value 0 has to be send.
3		setp_GenPower	0 ... 250 [%] (scPercent)	last value or default value (dependent on 0x4040:0x05)	Generator power limit for output INV B. If not used, the value 0 has to be send.
4 - 5		setp_Speed	-32000 ... 32255 [rpm] (scVeloc1)	last value or default value (dependent on 0x4050:0x05)	Velocity mode: Speed setpoint for motor B Torque mode: Speed limit for speed limitation
6 - 7		setp_Torque	-6400 ... 6451 [Nm] (scTorque1)	last value or default value (dependent on 0x4050:0x05)	Torque mode: Torque setpoint for motor A

7.3.4 Setpoints for onboard converter

CAN-ID		Cycle time	Timeout time	Transmitter	Receiver
0x18FF**z**3yy	Prio: 6, PGN: 0xFF**z**3, SA: yy	100 ms	500 ms	yy	MOBILE no. **z**
					z = address offset + 1 ▸ Device identification

Byte	Bit	Name	Value range (scaling)	Timeout value	Info
0	0 ... 1	ctrlPSU	0 ... 3	last value	Power Supply Unit (PSU): 0: Switch off PSU 1: Switch on PSU 2: Reserved 3: no data
	2 ... 7	-	-	-	Reserved
1		setp_DcLinkTolerance	0 ... 1000 [V] (scVolt2)	last value or default value (dependent on 0x4060:0x05)	This value is added to the setp_DcLinkVoltage setpoint or subtracted in order to obtain the maximum and minimum value of the DC-bus voltage required for derating. If not used, the value 0 has to be send.
2 - 3		-	-	-	Reserved
4		setp_Voltage	0 ... 50 [V] (scVolt1)	last value or default value (dependent on 0x4060:0x05)	Voltage setpoint for DC/DC converter
5		-	-	-	Reserved
4 - 5		setp_Voltage (as of version 5.4)	0 ... 64,255 [V] (scVolt1)	last value or default value (dependent on 0x4060:0x05)	Voltage setpoint for DC/DC converter
6 - 7		setp_ MaxCurrent	-1600 ... 1612.75 [A] (scCur1)	last value or default value (dependent on 0x4060:0x05)	Maximum output current for DC/DC converter In slave mode (several DC/DC converters in parallel), this value is set to the actual current value of the DC/DC master.

7.4 Public CAN transmit messages

Overview

The following table lists all transmit messages.

- The Identifier are based on the default setting of the MOBILE:
  - CAN address of the MOBILE = 234 (0xEA)
  - Device number = 1 (MOBILE 1)
- CAN address of the master control = 128 (0x80)
- The cycle time is preset for messages to 100 ms.

CAN-ID		MOBILE				Name	Detailed description
[decimal]	[hex]	PSU	DCU	DCU PSU	DCU S		
Prio: 6 PGN: 65280 SA: 234	0x18FF00EA	T	T	T	T	Transmit message 0	▸ Device status of the MOBILE
Prio: 6 PGN: 65281 SA: 234	0x18FF01EA	-	T	-	T	Transmit message 1	▸ Actual values from motor A
Prio: 6 PGN: 65282 SA: 234	0x18FF02EA	-	T	T	-	Transmit message 2	▸ Actual values from motor B
Prio: 6 PGN: 65283 SA: 234	0x18FF03EA	T	-	T	-	Transmit message 3	▸ Actual values from onboard converter

7.4.1 Device status of the MOBILE

CAN-ID		Cycle time	Transmitter	Receiver
0x18FF00yy	Prio: 6, PGN: 0xFF00, SA: yy	100 ms	MOBILE yy	All

Byte	Bit	Name	Value range (scaling)	Info
0	0 ... 1	DeviceState	0 ... 3	Status of the device identification: 0: Initialisation completed 1: Initialisation active 2: Reserved 3: no data
	2 ... 3	ErrorLamp	0 ... 3	Status of the error LED on the device (as group error message): 0: Error LED off 1: Error LED on 2: Reserved 3: no data
	4 ... 7	DEVICENUMBER	0 ... 15	Device number (dependent on the assignment of the ID pins): 0: not defined 1 ... 14: Device number 15: no data
1	0 ... 1	Clamp15_Status	0 ... 3	Status of terminal 15: 0: No terminal-15 signal 1: Terminal-15 signal 2: Reserved 3: no data
	2 ... 3	DCLinkChargeState	0 ... 3	Precharge status: 0: Precharge not completed 1: Precharge completed 2: Discharge completed (as of firmware R6.4) 3: no data ▸ Precharge function
	4 ... 5	Status_ Bit_Flex_In_Out _Signal1 (As of firmware R6.3)	0 ... 3	States of the mapped FLX_IN/OUT: 0: LOW signal (or no FLX_IN/OUT mapped) 1: HIGH signal 2: not defined 3: no data Mapping signal 1: 0x4025:0x02 Mapping signal 2: 0x4025:0x03
	6 ... 7	Status_ Bit_Flex_In_Out _Signal2 (As of firmware R6.3)	0 ... 3	
2 - 3		Error code	0 ... 65535	Error code: 0: No error 1 ... 65535: Error message ▸ Error messages, causes & and possible remedies
4		act_DCBusVoltage	0 ... 1000 [V] (scVolt2)	Current DC-bus voltage
5 - 6		act_DCBusPower	-160 ... 161.275 [kW] (scPower1)	Current DC-bus power (extrapolated)
7		act_DeviceTemperature	-40 ... 210 [°C] (scTemp1)	Current device temperature (PCB)

7.4.2 Actual values from motor A

CAN-ID		Cycle time	Transmitter	Receiver
0x18FF01yy	Prio: 6, PGN: 0xFF01, SA: yy	100 ms	MOBILE yy	All

Byte	Bit	Name	Value range (scaling)	Info
0	0 ... 1	act_InverterStatus	0 ... 3	Status of the power section: 0: power section inhibited 1: Power section enabled 2: Reserved 3: no data
	2 ... 3	act_InverterReady	0 ... 3	Status of the "InverterReady" signal: 0: Inverter not ready for operation 1: Inverter ready for operation 2: Reserved 3: no data
	4 ... 5	act_ErrorStatus	0 ... 3	Error status inverter/motor 0: No error 1: Error 2: Warning 3: no data
	6 ... 7	-	-	Reserved
1 - 2		act_Speed	-32000 ... 32255 [rpm] (scVeloc1)	Current speed
3 - 4		act_Torque	-6400 ... 6451 [Nm] (scTorque1)	Current torque As of firmware R6.3: Mapping can be changed in 0x4025:0x04.
5 - 6		act_Power	-160 ... 161.275 [kW] (scPower1)	Current output power
7		act_MotorTemperature	-40 ... 210 [°C] (scTemp1)	Current temperature As of firmware R6.3: Mapping can be changed in 0x4025:0x05.

7.4.3 Actual values from motor B

CAN-ID		Cycle time	Transmitter	Receiver
0x18FF02yy	Prio: 6, PGN: 0xFF02, SA: yy	100 ms	MOBILE yy	All

Byte	Bit	Name	Value range (scaling)	Info
0	0 ... 1	act_InverterStatus	0 ... 3	Status of the power section: 0: power section inhibited 1: Power section enabled 2: Reserved 3: no data
	2 ... 3	act_InverterReady	0 ... 3	Status of the "InverterReady" signal: 0: Inverter not ready for operation 1: Inverter ready for operation 2: Reserved 3: no data
	4 ... 5	act_ErrorStatus	0 ... 3	Error status inverter/motor 0: No error 1: Error 2: Warning 3: no data
	6 ... 7	-	-	Reserved
1 - 2		act_Speed	-32000 ... 32255 [rpm] (scVeloc1)	Current speed
3 - 4		act_Torque	-6400 ... 6451 [Nm] (scTorque1)	Current torque As of firmware R6.3: Mapping can be changed in 0x4025:0x06.
5 - 6		act_Power	-160 ... 161.275 [kW] (scPower1)	Current output power
7		act_MotorTemperature	-40 ... 210 [°C] (scTemp1)	Current temperature As of firmware R6.3: Mapping can be changed in 0x4025:0x07.

7.4.4 Actual values from onboard converter

CAN-ID		Cycle time	Transmitter	Receiver
0x18FF03yy	Prio: 6, PGN: 0xFF03, SA: yy	100 ms	MOBILE yy	All

Byte	Bit	Name	Value range (scaling)	Info
0	0 ... 1	act_InverterStatus	0 ... 3	Status of the power section: 0: power section inhibited 1: Power section enabled 2: Reserved 3: no data
	2 ... 3	act_InverterReady	0 ... 3	Status of the "InverterReady" signal: 0: Inverter not ready for operation 1: Inverter ready for operation 2: Reserved 3: no data
	4 ... 5	act_ErrorStatus	0 ... 3	Error status of inverter A (DC/DC) 0: No error 1: Error 2: Warning 3: no data
	6 ... 7	-	-	Reserved
1		act_Voltage	0 ... 50 [V] (scVolt1)	Current DC/DC voltage
2		-	-	Reserved
1 - 2		act_Voltage (as of version 5.4)	0 ... 64,255 [V] (scVolt1)	Current DC/DC voltage
3 - 4		act_Current	-1600 ... 1612.75 [A] (scCur1)	Current DC/DC current
5 - 6		act_Power	-160 ... 161.275 [kW] (scPower1)	Current output power
7		act_Temperature	-40 ... 210 [°C] (scTemp1)	Current temperature As of firmware R6.3: Mapping can be changed in 0x4025:0x08.

8 Unified Diagnostic Services (UDS)

For transmitting diagnostic messages via CAN bus, the ISO transport protocol (ISO 15765-2) is used.

Information on how to implement the Unified Diagnostic Services can be found in the ISO 15765, Part 3: "Implementation of unified diagnostic services (UDS on CAN)".

8.1 General structure of the diagnostic messages

Message type	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4 ... n
Request without subfunction	Message length	Service ID (SID)	Request parameters		
Request with subfunction	Message length	Service ID (SID)	Subfunction	Request parameters	
Positive Response	Message length	SID + 0x40	Response parameters		
Negative Response	Message length	Error ID (0x7F)	Request SID	Response code	-

▸ Example: read out SAG bootloader name: (📖 195)

8.2 Protocol services

This chapter describes all protocol services supported by the MOBILE in detail.

The "Services" overview table provides a first overview of the supported protocol services and contains numerous additional information on each service.

8.2.1 "Services" overview

The following table lists all protocol services supported by the MOBILE.

Information on the meaning of the single columns can be found here.

Services	Request (prefix)	● = services available in the session (session after execution)			Request		Positive response		SPRMIB		Required
		Default	Programming (Bootloader)	Extended	physical	functional	physical	functional	physical	functional	
§10: Diagnostic Session Control											
- Default Session	10 01	●	● (Default)	● (Default)	●	●	●	●	0/1	0/1	●
- Programming Session	10 02	-	● (Programming)	● (Programming)	●	●	●	●	0/1	0/1	●
- Extended Diagnostic Session	10 03	● (Extended)	● (Extended)	● (Extended)	●	●	●	●	0/1	0/1	●
§11: ECU Reset											
- Hard Reset	11 01	●	● (Default)	● (Default)	●	●	●	●	0/1	0/1	-
§14: Clear Diagnostic Information	14 xx	●	-	●	●	●	●	●	-	-	-
§19: Read DTC Information											
- Report number of DTC by status mask	19 01 xx	●	-	●	●	●	●	●	0/1	0/1	-
- Report DTC by status mask	19 02 xx	●	-	●	●	●	●	●	0/1	0/1	-
- Report DTC snapshot record by DTC number	19 04 xx ...	●	-	●	●	●	●	●	0/1	0/1	-
- Report supported DTC	19 0A	●	-	●	●	●	●	●	0/1	0/1	-
§22: Read Data By Identifier											
- SAG Dataset Version	22 F1 F8 xx	●	-	●	●	●	●	●	-	-	-
- SAG Device Hardware Version	22 F1 F7 xx	●	-	●	●	●	●	●	-	-	-
- SAG Device Serial Number	22 F1 F6 xx	●	-	●	●	●	●	●	-	-	-
- SAG Device Product Type	22 F1 F5 xx	●	-	●	●	●	●	●	-	-	-
- Read Fingerprint	22 F1 5B xx	●	-	●	●	●	●	●	-	-	-
- SAG Application Data Size	22 F1 F4 xx	●	-	●	●	●	●	●	-	-	-
- SAG Firmware Name	22 F1 F0 xx	●	-	●	●	●	●	●	-	-	-
- SAG Bootloader Name	22 F1 F1 xx	●	●	●	●	●	●	●	-	-	-
- SAG Dataset Name	22 F1 F2 xx	●	-	●	●	●	●	●	-	-	-
- SAG Dataset Size	22 F1 F3 xx	●	-	●	●	●	●	●	-	-	-
§27: Security Access											
- Request seed	27 11	-	●	●	●	●	●	●	0/1	0/1	-
- Send key	27 12 xx	-	●	●	●	●	●	●	0/1	0/1	-

Services	Request (prefix)	● = services available in the session (session after execution)			Request		Positive response		SPRMIB		Required
		Default	Programming (Bootloader)	Extended	physical	functional	physical	functional	physical	functional	
$28: Communication Control											
- EnableRxAndEnableTx	28 00 xx	-	-	●	●	●	●	●	0/1	0/1	-
- EnableRxAndDisableTx	28 01 xx	-	-	●	●	●	●	●	0/1	0/1	
$31: Routine Control											
- Fault Reset	31 01 F2 00 xx		-	●	●	●	●	●	0/1	0/1	-
- EnablePrivateCAN	31 01 F1 00 xx		-	●	●	●	●	●	0/1	0/1	-
- Restore Parameter Set	31 01 FE 02 xx		-	●	●	●	●	●	0/1	0/1	-
- Store Parameter Set	31 01 FE 01 xx		-	●	●	●	●	●	0/1	0/1	-
- Check Programming Preconditions	31 01 02 03 xx	-	●	●	●	●	●	●	0/1	0/1	-
$34: Request Download	34 xx xx	-	●	-	●	●	●	●	-	-	-
$35: Request Upload	35 xx xx	-	-	●	●	●	●	●	-	-	-
$36: Transfer Data	36 xx ...	-	●	●	●	(●)	●	(●)	-	-	-
$37: Request Transfer Exit	37 xx	-	●	●	●	●	●	●	-	-	-
$3E: Tester Present	3E 00	●	●	●	●	●	●	●	0/1	0/1	●
$85: Control DTC Setting											
- On	85 01 xx ...	-	-	●	●	●	●	●	0/1	0/1	-
- Off	85 02 xx ...	-	-	●	●	●	●	●	0/1	0/1	-

How to read the overview table:

Column	Meaning
Services	SID and name of the services / name of the subfunction
Request (prefix)	Prefix of the byte sequence for the request
Status dependencies	
Default/Programming/Extended	● = The service can be carried out in the prevailing session. If the MOBILE is in a different session after the service has been executed, it will be indicated in brackets.
Preset addressing methods	
physical	● = test system transmits physical request
Request: functional	● = test system transmits functional request (●) = the diagnostic instance provides services which deviate from this default setting.
Preset response behaviour	
Positive response: physical	● = MOBILE transmits physical positive response
Positive response: functional	● = MOBILE transmits functional positive response (●) = the diagnostic instance provides services which deviate from this default setting.
SPRMIP - Suppress Positive Message Indication Bit	
SPRMIB: physical	Test system is to set the SPRMIB in the physical request: 1 = always (SPRMIB is always 1) 0/1 = user-defined (SPRMIB can be 0 or 1) 0 = never (SPRMIB is always 0)
SPRMIB: functional	Test is to set the SPRMIB in the functional request: 1 = always (SPRMIB is always 1) 0/1 = user-defined (SPRMIB can be 0 or 1) 0 = never (SPRMIB is always 0)
Further information	
Required	● = there is at least one service in a required, activated diagnostic instance of the basic version

8.2.2 $10: Diagnostic Session Control

This service serves to change to a different session.

- At the start, the MOBILE is by default in the "default session".
- Depending on the active session, different services are activated.

Request			
Byte	Name	Cvt	Value
1	SID-RQ	M	$10
2	Subfunction*	M	$01: Default Session $02: Programming Session $03: Extended Diagnostic Session
* Bit 7 = Suppress Positive Response Message Indication Bit (SPRMIB)			

Positive Response			
Byte	Name	Cvt	Value
1	SID-PR	M	$50
2	Subfunction	M	$01: Default Session $02: Programming Session $03: Extended Diagnostic Session
3 - 6	SessionParameterRecord	M	

Negative Response			
Byte	Name	Cvt	Value
1	SID-NR	M	$7F
2	SIDRQ-NO	M	$10
3	Response code	M	▸ Negative Response Codes
	Value	Meaning	
	0x12	Subfunction not supported	
	0x13	Incorrect message length or invalid format	
	0x22	Conditions not correct	
	0x7E	Subfunction not supported in active session	

Tip!

The "Services" overview table shows which services are to be executed in which session and in which state the MOBILE is after the service has been executed.

8.2.3 $11: ECU Reset

This service serves to restart the MOBILE. The "Hard Reset" simulates the interruption of the voltage supply.

Request			
Byte	Name	Cvt	Value
1	SID-RQ	M	$11
2	Subfunction*	M	$01: Hard Reset
* Bit 7 = Suppress Positive Response Message Indication Bit (SPRMIB)			

Positive Response			
Byte	Name	Cvt	Value
1	SID-PR	M	$51
2	Subfunction	M	$01: Hard Reset
3	PowerDownTime	U	

Negative Response			
Byte	Name	Cvt	Value
1	SID-NR	M	$7F
2	SIDRQ-NO	M	$11
3	Response code	M	▸ Negative Response Codes
	Value	Meaning	
	0x12	Subfunction not supported	
	0x13	Incorrect message length or invalid format	
	0x22	Conditions not correct	
	0x33	Security access denied	

8.2.4 $14: Clear Diagnostic Information

This service serves to delete the entire error memory of the MOBILE or just a certain group of errors.

Request			
Byte	Name	Cvt	Value
1	SID-RQ	M	$14
2 - 4	GroupOfDtc	M	

Positive Response			
Byte	Name	Cvt	Value
1	SID-PR	M	$54

Negative Response			
Byte	Name	Cvt	Value
1	SID-NR	M	$7F
2	SIDRQ-NO	M	$14
3	Response code	M	▸ Negative Response Codes

Value	Meaning
0x13	Incorrect message length or invalid format
0x22	Conditions not correct
0x31	Request out of range

8.2.5 $19: Read DTC Information

This service serves to read out the error memory of the MOBILE.

Subfunction	Info
$01: Report number of DTC by status mask	
$02: Report DTC by status mask	
$04: Report DTC snapshot record by DTC number	
$0A: Report supported DTC	

More information on the error memory of the MOBILE can be found in the chapter "Diagnostics & error management". ▸ Error memory (📖 219)

Report number of DTC by status mask

Request			
Byte	Name	Cvt	Value
1	SID-RQ	M	$19
2	Subfunction*	M	$01: Report number of DTC by status mask
3	DTCStatusMask	M	
	Bit: Meaning		
	0: Test failed		
	1: Test failed this operation cycle		
	2: Reserved		
	3: Confirmed DTC		
	4: Reserved		
	5: Test failed since last clear		
	6: Reserved		
	7: Reserved		
* Bit 7 = Suppress Positive Response Message Indication Bit (SPRMIB)			

Positive Response			
Byte	Name	Cvt	Value
1	SID-PR	M	$59
2	Subfunction	M	$01: Report number of DTC by status mask
3	DTCStatusAvailabilityMask	M	
	Bit: Meaning		
	0: Test failed		
	1: Test failed this operation cycle		
	2: Reserved		
	3: Confirmed DTC		
	4: Reserved		
	5: Test failed since last clear		
	6: Reserved		
	7: Reserved		
4	DTCFormatIdentifier	M	
5 - 6	DTCCount	M (fd)	

Negative Response			
Byte	Name	Cvt	Value
1	SID-NR	M	$7F
2	SIDRQ-NO	M	$19
3	Response code	M	▸ Negative Response Codes
	Value: Meaning		
	0x12: Subfunction not supported		
	0x13: Incorrect message length or invalid format		
	0x31: Request out of range		

Report DTC by status mask

Request			
Byte	Name	Cvt	Value
1	SID-RQ	M	$19
2	Subfunction*	M	$02: Report DTC by status mask
3	DTCStatusMask	M	

Bit	Meaning
0	Test failed
1	Reserved
2	Reserved
3	Confirmed DTC
4	Test not completed since last clear
5	Test failed since last clear
6	Test not completed this monitoring cycle
7	Reserved

* Bit 7 = Suppress Positive Response Message Indication Bit (SPRMIB)

Positive Response			
Byte	Name	Cvt	Value
1	SID-PR	M	$59
2	Subfunction*	M	$02: Report DTC by status mask
3	DTCStatusAvailabilityMask	M	

Bit	Meaning
0	Test failed
1	Reserved
2	Reserved
3	Confirmed DTC
4	Test not completed since last clear
5	Test failed since last clear
6	Test not completed this monitoring cycle
7	Reserved

4 ... n	(DTC, StatusOfDTC)*	M	* Number of repetitions: 1 ... number of DTC

Byte	Meaning
1 - 3	DTC ▸ Diagnostic Trouble Codes (DTC)
4	StatusOfDTC (for bit assignment, see DTCStatusMask)

Negative Response			
Byte	Name	Cvt	Value
1	SID-NR	M	$7F
2	SIDRQ-NO	M	$19
3	Response code	M	▸ Negative Response Codes

Value	Meaning
0x12	Subfunction not supported
0x13	Incorrect message length or invalid format
0x31	Request out of range

Report DTC snapshot record by DTC number

Request			
Byte	Name	Cvt	Value
1	SID-RQ	M	$19
2	Subfunction*	M	$04: Report DTC snapshot record by DTC number
3 - 5	DTC	M	▸ Diagnostic Trouble Codes (DTC)
6	SnapshotRecordNumber	M	(Default)
* Bit 7 = Suppress Positive Response Message Indication Bit (SPRMIB)			

Positive Response			
Byte	Name	Cvt	Value
1	SID-PR	M	$59
2	Subfunction	M	$04: Report DTC snapshot record by DTC number
3 - 5	DTC	M	▸ Diagnostic Trouble Codes (DTC)
6	StatusOfDTC	M	

Bit	Meaning
0	Test failed
1	Reserved
2	Reserved
3	Confirmed DTC
4	Test not completed since last clear
5	Test failed since last clear
6	Test not completed this monitoring cycle
7	Reserved

7 ... n	(SnapshotRecordAndNumber)*	M	* Number of repetitions: 1 ... number of records

Byte	Meaning
1	Record number
2	Number of Identifiers
3 - 4	Identifier
5 - 37	csEntry

Negative Response			
Byte	Name	Cvt	Value
1	SID-NR	M	$7F
2	SIDRQ-NO	M	$19
3	Response code	M	▸ Negative Response Codes

Value	Meaning
0x12	Subfunction not supported
0x13	Incorrect message length or invalid format
0x31	Request out of range

Report supported DTC

Request			
Byte	Name	Cvt	Value
1	SID-RQ	M	$19
2	Subfunction*	M	$0A: Report supported DTC
* Bit 7 = Suppress Positive Response Message Indication Bit (SPRMIB)			

Positive Response			
Byte	Name	Cvt	Value
1	SID-PR	M	$59
2	Subfunction	M	$0A: Report supported DTC
3	DTCStatusAvailabilityMask	M	
	Bit: Meaning		
	0: Test failed		
	1: Reserved		
	2: Reserved		
	3: Confirmed DTC		
	4: Test not completed since last clear		
	5: Test failed since last clear		
	6: Test not completed this monitoring cycle		
	7: Reserved		
4 ... n	(DTC, StatusOfDTC)*	M	* Number of repetitions: 1 ... number of DTC
	Byte: Meaning		
	1 - 3: DTC ▸ Diagnostic Trouble Codes (DTC)		
	4: StatusOfDTC		

Negative Response			
Byte	Name	Cvt	Value
1	SID-NR	M	$7F
2	SIDRQ-NO	M	$19
3	Response code	M	▸ Negative Response Codes
	Value	Meaning	
	0x12	Subfunction not supported	
	0x13	Incorrect message length or invalid format	
	0x31	Request out of range	

8.2.6 $22: Read Data By Identifier

This service serves to query data of the MOBILE. A request may combine several different identifiers, as a response, these identifiers will be transmitted with the corresponding data.

Request			
Byte	Name	Cvt	Value
1	SID-RQ	M	$22
2	Identifier (high byte)	M	$F1F8: SAG Dataset Version $F1F7: SAG Device Hardware Version $F1F6: SAG Device Serial Number $F1F5: SAG Device Product Type $F15B: Read Fingerprint $F1F4: SAG Application Data Size $F1F0: SAG Firmware Name $F1F1: SAG Bootloader Name $F1F2: SAG Dataset Name $F1F3: SAG Dataset Size $F190: Vehicle Identification
3	Identifier (low byte)	M	

Positive Response			
Byte	Name	Cvt	Value
1	SID-PR	M	$62
2	Identifier (high byte)	M	$F1F8: SAG Dataset Version $F1F7: SAG Device Hardware Version $F1F6: SAG Device Serial Number $F1F5: SAG Device Product Type $F15B: Read Fingerprint $F1F4: SAG Application Data Size $F1F0: SAG Firmware Name $F1F1: SAG Bootloader Name $F1F2: SAG Dataset Name $F1F3: SAG Dataset Size $F190: Vehicle Identification
3	Identifier (low byte)	M	
4 -n	DataRecord	M	

Negative Response			
Byte	Name	Cvt	Value
1	SID-NR	M	$7F
2	SIDRQ-NO	M	$22
3	Response code	M	▸ Negative Response Codes
	Value	Meaning	
	0x13	Incorrect message length or invalid format	
	0x22	Conditions not correct	
	0x31	Request out of range	
	0x33	Security access denied	

Example: read out SAG bootloader name:

	Byte 1	Byte 2	Byte 3	Byte 4 - 18
Request	0x22	0xF1	0xF1	-
Positive Response	0x62	0xF1	0xF1	SAG Bootloader Name (11 ... 15 characters)

8.2.7 $27: Security Access

This service serves to activate safety-critical services in the MOBILE. The Security Access is based on a "Seed & Key" procedure:

1. Using the "Request seed" subfunction, the tester requests a random number from the MOBILE. The tester calculates a key from the random number using a secret algorithm.
2. By means of the "Send key" subfunction, this key will be returned to the MOBILE.
3. In the same manner, the MOBILE calculates the key from the random number and compares it with the key received by the tester.
4. If both keys are identical, the MOBILE enables the corresponding services and confirms it by a positive response.

Overview of safety-critical services

Services	Request (prefix)	● = service available in the status (status after execution)	
		Locked	Unlocked L1
$10: Diagnostic Session Control			
- Default Session	10 01	●	● (Locked)
- Programming Session	10 02	●	● (Locked)
- Extended Diagnostic Session	10 03	●	● (Locked)
$11: ECU Reset			
- Hard Reset	11 01	●	● (Locked)
$27: Security Access			
- Send key	27 12 xx	● (Unlocked L1)	-

Request seed

Request			
Byte	Name	Cvt	Value
1	SID-RQ	M	$27
2	Subfunction*	M	$11: Request seed
* Bit 7 = Suppress Positive Response Message Indication Bit (SPRMIB)			

Positive Response			
Byte	Name	Cvt	Value
1	SID-PR	M	$67
2	Subfunction	M	$11: Request seed
3 - n	SecuritySeed	M	

Negative Response			
Byte	Name	Cvt	Value
1	SID-NR	M	$7F
2	SIDRQ-NO	M	$27
3	Response code	M	▸ Negative Response Codes

Value	Meaning
0x12	Subfunction not supported
0x13	Incorrect message length or invalid format
0x22	Conditions not correct
0x24	Request sequence error
0x31	Request out of range
0x35	Invalid key
0x36	Exceed number of attempts
0x37	Required time delay not expired

Send key

Request			
Byte	Name	Cvt	Value
1	SID-RQ	M	$27
2	Subfunction*	M	$12: Send key
3 - n	SecurityKey	M	
* Bit 7 = Suppress Positive Response Message Indication Bit (SPRMIB)			

Positive Response			
Byte	Name	Cvt	Value
1	SID-PR	M	$67
2	Subfunction	M	$12: Send key

Negative Response			
Byte	Name	Cvt	Value
1	SID-NR	M	$7F
2	SIDRQ-NO	M	$27
3	Response code	M	▸ Negative Response Codes
	Value	Meaning	
	0x12	Subfunction not supported	
	0x13	Incorrect message length or invalid format	
	0x22	Conditions not correct	
	0x24	Request sequence error	
	0x31	Request out of range	
	0x35	Invalid key	
	0x36	Exceed number of attempts	
	0x37	Required time delay not expired	

8.2.8 $28: Communication Control

This service serves to deactivate the transfer of the Tx-PDOs.

Request			
Byte	Name	Cvt	Value
1	SID-RQ	M	$28
2	Subfunction*	M	$00: enableRxAndTx $01: enableRxAndDisableTx
3	CommunicationType	M	
* Bit 7 = Suppress Positive Response Message Indication Bit (SPRMIB)			

Positive Response			
Byte	Name	Cvt	Value
1	SID-PR	M	$68
2	Subfunction	M	$00: enableRxAndTx $01: enableRxAndDisableTx

Negative Response			
Byte	Name	Cvt	Value
1	SID-NR	M	$7F
2	SIDRQ-NO	M	$28
3	Response code	M	▸ Negative Response Codes
	Value	Meaning	
	0x12	Subfunction not supported	
	0x13	Incorrect message length or invalid format	
	0x22	Conditions not correct	
	0x31	Request out of range	
	0x33	Security access denied	

8.2.9 $31: Routine Control

This service and the supported "start routine" subfunction serve to start different services in the MOBILE.

Request			
Byte	Name	Cvt	Value
1	SID-RQ	M	$31
2	Subfunction*	M	$01: Start routine
3	Identifier (high byte)	M	$F200: Fault Reset $F100: EnablePrivateCAN $FE02: Restore Parameter Set $FE01: Store Parameter Set $F000: EnableTMO $0203: Check Programming Preconditions
4	Identifier (low byte)	M	
5 - n	RoutineControlOptionRecord	-	
* Bit 7 = Suppress Positive Response Message Indication Bit (SPRMIB)			

Positive Response			
Byte	Name	Cvt	Value
1	SID-PR	M	$71
2	Subfunction	M	$01: Start routine
3	Identifier (high byte)	M	$F200: Fault Reset $F100: EnablePrivateCAN $FE02: Restore Parameter Set $FE01: Store Parameter Set $F000: EnableTMO $0203: Check Programming Preconditions
4	Identifier (low byte)	M	
5 - n	RoutineStatusRecord	-	

Negative Response			
Byte	Name	Cvt	Value
1	SID-NR	M	$7F
2	SIDRQ-NO	M	$31
3	Response code	M	▸ Negative Response Codes

Value	Meaning
0x12	Subfunction not supported
0x13	Incorrect message length or invalid format
0x22	Conditions not correct
0x24	Request sequence error
0x31	Request out of range
0x33	Security access denied
0x72	General programming failure

8.2.10 $34: Request Download

This service serves to start the transfer from the data of the test system to the MOBILE. The real data transfer is then carried out using the "Transfer Data" service.

Request			
Byte	Name	Cvt	Value
1	SID-RQ	M	$34
2	DataFormatIdentifier	M	
3	Address and Length Format Identifier	M (fd)	
4 - n	Address and Size	M (fd)	

Positive Response			
Byte	Name	Cvt	Value
1	SID-PR	M	$74
2	LengthFormatIdentifier	M	
3 - n	MaxNumberOfBlockLength	M	

Negative Response			
Byte	Name	Cvt	Value
1	SID-NR	M	$7F
2	SIDRQ-NO	M	$34
3	Response code	M	▸ Negative Response Codes

Value	Meaning
0x13	Incorrect message length or invalid format
0x22	Conditions not correct
0x31	Request out of range
0x33	Security access denied
0x70	Upload / Download not accepted

8.2.11 $35: Request Upload

This service serves to start the transfer from the data of the MOBILE to the test system. The real data transfer is then carried out using the "Transfer Data" service.

Request			
Byte	Name	Cvt	Value
1	SID-RQ	M	$35
2	DataFormatIdentifier	M	
3	Address and Length Format Identifier	M (fd)	
4 - n	Memory Address and Size	M (fd)	

Positive Response			
Byte	Name	Cvt	Value
1	SID-PR	M	$75
2	FormatIdentifier	M	
3 - n	MaxNumberOfBlockLength	M	

Negative Response			
Byte	Name	Cvt	Value
1	SID-NR	M	$7F
2	SIDRQ-NO	M	$35
3	Response code	M	▸ Negative Response Codes

Value	Meaning
0x13	Incorrect message length or invalid format
0x22	Conditions not correct
0x31	Request out of range
0x33	Security access denied
0x70	Upload / Download not accepted

8.2.12 $36: Transfer Data

This service serves to transfer data between the test system and the MOBILE. For determining the transfer direction and data size, the service "Request Download" or "Request Upload" must have been executed before.

Request			
Byte	Name	Cvt	Value
1	SID-RQ	M	$36
2 - n	Data	M	

Positive Response			
Byte	Name	Cvt	Value
1	SID-PR	M	$76
2 - n	Data	M	

Negative Response			
Byte	Name	Cvt	Value
1	SID-NR	M	$7F
2	SIDRQ-NO	M	$36
3	Response code	M	▸ Negative Response Codes

Value	Meaning
0x13	Incorrect message length or invalid format
0x22	Conditions not correct
0x24	Request sequence error
0x31	Request out of range
0x71	Transfer data suspended
0x72	General programming failure
0x73	Wrong block sequence counter
0x92	Voltage too high
0x93	Voltage too low

8.2.13 $37: Request Transfer Exit

A previously started data transfer always needs to be completed with this service.

Request			
Byte	Name	Cvt	Value
1	SID-RQ	M	$37
2 - n	RequestParameter	-	

Positive Response			
Byte	Name	Cvt	Value
1	SID-PR	M	$77
2 - n	ResponseParameter	-	

Negative Response			
Byte	Name	Cvt	Value
1	SID-NR	M	$7F
2	SIDRQ-NO	M	$37
3	Response code	M	▸ Negative Response Codes

Value	Meaning
0x13	Incorrect message length or invalid format
0x22	Conditions not correct
0x24	Request sequence error

8.2.14 $3E: Tester Present

If no communication takes place with the test system for a longer while, the MOBILE automatically changes to the "Default Session". This service enables the test system to signal the MOBILE the it is still available and the current session should not be left.

Request			
Byte	Name	Cvt	Value
1	SID-RQ	M	$3E
2	Subfunction*	M	$00: No subfunction
* Bit 7 = Suppress Positive Response Message Indication Bit (SPRMIB)			

Positive Response			
Byte	Name	Cvt	Value
1	SID-PR	M	$7E
2	Subfunction	M	$00: No subfunction

Negative Response			
Byte	Name	Cvt	Value
1	SID-NR	M	$7F
2	SIDRQ-NO	M	$3E
3	Response code	M	▸ Negative Response Codes
	Value	Meaning	
	0x12	Subfunction not supported	
	0x13	Incorrect message length or invalid format	

8.2.15 $85: Control DTC Setting

This service serves to switch off and on again the identification of single or all errors at once.

Request			
Byte	Name	Cvt	Value
1	SID-RQ	M	$85
2	Subfunction*	M	$01: On $02: Off
3 - n	DTCSettingControlOptionRecord	U	
* Bit 7 = Suppress Positive Response Message Indication Bit (SPRMIB)			

Positive Response			
Byte	Name	Cvt	Value
1	SID-PR	M	$C5
2	Subfunction	M	$01: On $02: Off

Negative Response			
Byte	Name	Cvt	Value
1	SID-NR	M	$7F
2	SIDRQ-NO	M	$85
3	Response code	M	▸ Negative Response Codes
	Value	Meaning	
	0x12	Subfunction not supported	
	0x13	Incorrect message length or invalid format	
	0x22	Conditions not correct	
	0x31	Request out of range	

8.3 Negative Response Codes

If a received request from the control device cannot be processed, the control device responds with one of the following negative response codes (depending on the type of error). Specific negative response codes are described in the prevailing protocol service.

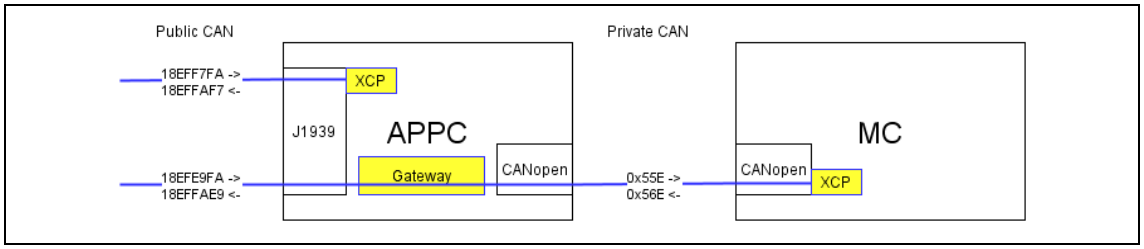
Supported Negative Response Codes:

Negative Response Code	
0x10	General reject
0x11	Service not supported
0x12	Subfunction not supported
0x13	Incorrect message length or invalid format
0x14	Response too long
0x21	Busy repeat request
0x22	Conditions not correct
0x24	Request sequence error
0x31	Request out of range
0x33	Security access denied
0x35	Invalid key
0x36	Exceed number of attempts
0x37	Required time delay not expired
0x70	Upload / Download not accepted
0x71	Transfer data suspended
0x72	General programming failure
0x73	Wrong block sequence counter
0x78	Request correctly received - response pending
0x7E	Subfunction not supported in active session
0x7F	Service not supported in active session
0x81	RPM too high
0x82	RPM too low
0x83	Engine is running
0x84	Engine is not running
0x85	Engine runtime too low
0x86	Temperature too high
0x87	Temperature too low
0x88	Vehicle speed too high
0x89	Vehicle speed too low
0x8A	Throttle / Pedal too high
0x8B	Throttle / Pedal too low
0x8C	Transmission range not in neutral
0x8D	Transmission range not in gear
0x8F	Break switch(es) not closed
0x90	Shifter lever not in park
0x91	Torque converter clutch locked
0x92	Voltage too high
0x93	Voltage too low

9 Universal Measurement and Calibration Protocol (XCP)

XCP access is provided via Public CAN to the APPC and the MC. The APPC and MC are each a separate XCP device. For MC access, the APPC acts as a gateway. XCP can be used to access all objects in the object directory. The A2L file that contains all signals is included in each firmware package and can, for instance, be integrated in the software "Vector CANape".

Direct memory access via XCP is not possible. The read and write restrictions are the same as those for the CANopen protocol.



[9-1] XCP communication

9.1 CAN IDs Public CAN

Standard IDs

Microcontroller	Direction	Public CAN	Parameter
XCP on APPC	Command	0x18EFF7FA	0x4023:0x10
	Response	0x18EFFAF7	0x4021:0x10
XCP on MC	Command	0x18EFE9FA	0x4023:0x11
	Response	0x18EFFAE9	0x4021:0x11

The CAN IDs depend on the basic XCP addresses and the address offset (ID pins). For the precise composition, refer to the corresponding parameter descriptions (A2L files).

9.2 Supported XCP message types

Abbreviation	PID[1)]	Name	Explanation
CMD	0xC0 ... 0xFF	Command Packet	Sending commands
RES	0xFF	Command Response Packet	Positive response
ERR	0xFE	Error	Negative response
DAQ	0x00 ... 0xFB[2)]	Data AcQuisition	Sending cyclical measurement data

1) PID = Packet IDentifier

2) To signal an overflow situation for DAQ, the highest value bit of PID is used by the next successfully transmitted package. This limits the maximum possible ODT number (= PID for DAQ) to 0x7B

9.3 Supported commands

The commands described below are supported as of firmware R6.4.

9.3.1 STANDARD COMMANDS (STD)

Command	Code
CONNECT	0xFF
DISCONNECT	0xFE
GET_STATUS	0xFD
SYNCH	0xFC
GET_COMM_MODE_INFO	0xFB
GET_ID	0xFA
GET_SEED	0xF8
UNLOCK	0xF7
SET_MTA	0xF6
UPLOAD	0xF5
SHORT_UPLOAD	0xF4

9.3.2 CALIBRATION COMMANDS (CAL)

Command	Code
DOWNLOAD	0xF0

9.3.3 DATA ACQUISITION AND STIMULATION COMMANDS (DAQ)

Only Data Acquisition is supported, but not Data Stimulation.

- SET_DAQ_LIST_MODE: Mode, Bit DIRECTION = 0 (DAQ)

Basics

Command	Code
SET_DAQ_PTR	0xE2
WRITE_DAQ	0xE1
SET_DAQ_LIST_MODE	0xE0
START_STOP_DAQ_LIST	0xDE
START_STOP_SYNCH	0xDD
GET_DAQ_CLOCK	0xDC
GET_DAQ_PROCESSOR_INFO	0xDA
GET_DAQ_RESOLUTION_INFO	0xD9
GET_DAQ_LIST_MODE	0xDF

Static configuration

Is not supported.

Dynamic configuration

Command	Code
FREE_DAQ	0xD6
ALLOC_DAQ	0xD5
ALLOC_ODT	0xD4
ALLOC_ODT_ENTRY	0xD3

For Data Acquisition (DAQ), the measurements are performed at specific times, then sent to the XCP master. Pre-defined events are used to select the time before the start of the measurement. 3 cyclical events are available both on the APPC and on the MC: 10 ms, 100 ms and 1 s.

Data consistency throughout a complete DAQ cannot be guaranteed.

9.4 XCP write access and DAQ enable

The acyclic read access (polling) is available without an additional enable.

The calibration function (writing parameters) and Data Acquisition (device sends measured values cyclically) is protected by a seed&key process.

For both seed&key processes, the DLL file is included in the firmware package and can, for instance, be integrated in the software "VECTOR CANape".

10 Diagnostics & error management

This chapter contains information on the drive diagnostics, error handling, and fault analysis.

Related topics:

- Device status

10.1 Trace function

The trace function can be used to support commissioning, maintenance and troubleshooting. The trace function serves to cyclically detect the current values of selected objects of the MOBILE and represent them graphically in the "MOBILE Engineer".

- The trace function is not include in the "MOBILE Starter".

Online/offline trace

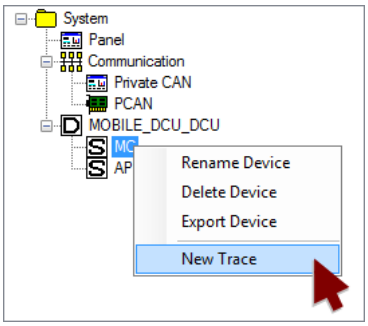
Depending on the application case, you can select between online and offline trace; the differences are shown in the following table:

Feature	Online trace	Offline trace
General information	The data values are continuously read "live" by the MOBILE and immediately visualised in the »MOBILE Engineer«.	The data values are first stored temporarily in the internal memory of the MOBILE. Only if the trace has been executed completely, the data values will be transferred to the »MOBILE Engineer«. This allows for a much more accurate detection.
Minimum sampling rate	approx. 100 ms	approx. 50 µs (DCU: 64 µs, PSU: 32 µs)
Maximum time period	unlimited	limited (depending on the selected time interval, the number of channels and the memory available in the device)
Maximum number of channels	unlimited	8 channels with a data width of 16 bits each (32-bit values assign 2 channels)
Trigger conditions	No	yes: • Bit pattern comparison • Simple comparison • Application-specific comparison

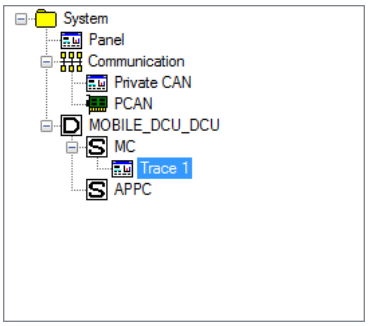
10.1.1 Creating a new trace

How to create a new trace:

1. Right-click the device in the *system browser* for which a new trace is to be created.
   - For this step-by-step instructions, the Motor Controller (MC) of the MOBILE has been selected as device.
2. In the *context menu* displayed now for the device, execute the **New Trace** command:



As a result, a new trace with a unique name in the "Trace <n>" format is attached to the device:

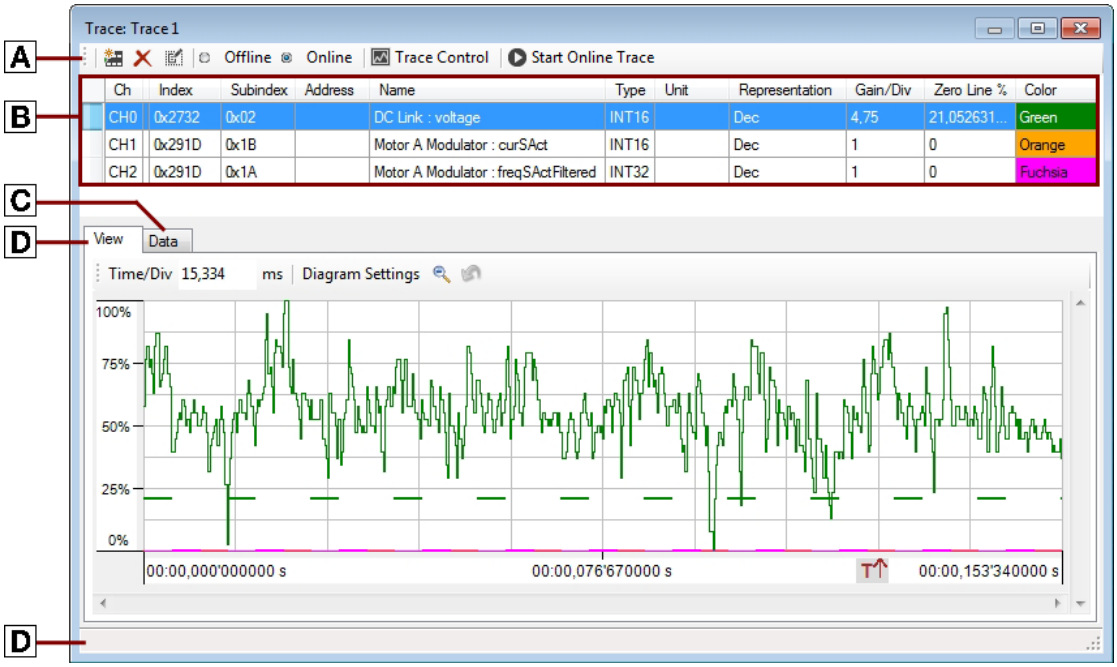


3. Optional: Change name of the trace.
   - For this purpose, execute the **Rename Trace** command in the *context menu*.

10.1.2 User interface (trace panel)

If you click a trace in the *system browser*, the corresponding trace panel is opened.

The trace panel contains the following control and function elements:



A Trace toolbar

B Channel configuration

C Display of the trace data in table form

D Diagram presentation

E Status bar

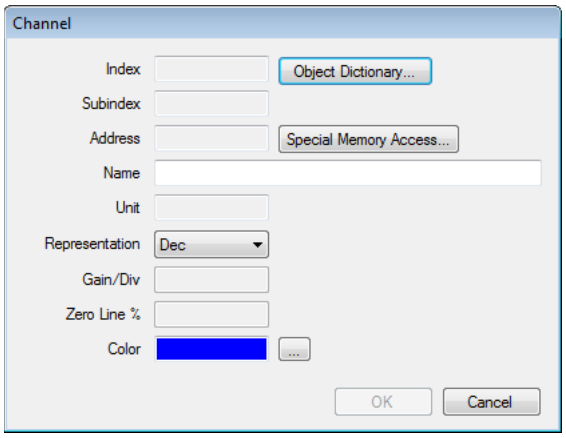
Trace toolbar

Icon/command	Function	Info
	Add new channel	▸ Adding and configuring channels
	Remove selected channel	
	Configure selected channel	
Offline/online	Selection of the trace mode	
Trace Control	Menu with the following command:	
	Configuration...	▸ Configuring the trace function
	Download Offline Trace Configuration	▸ Download/upload functions
	Upload Offline Trace Configuration	
	Upload Offline Trace Configuration And Data	
	Delete Data	
Start Offline Trace	Only in case the trace mode "offline" has been selected: Start offline trace	▸ Start trace function
Start online trace	Only in case the trace mode "online" has been selected: Start online trace	

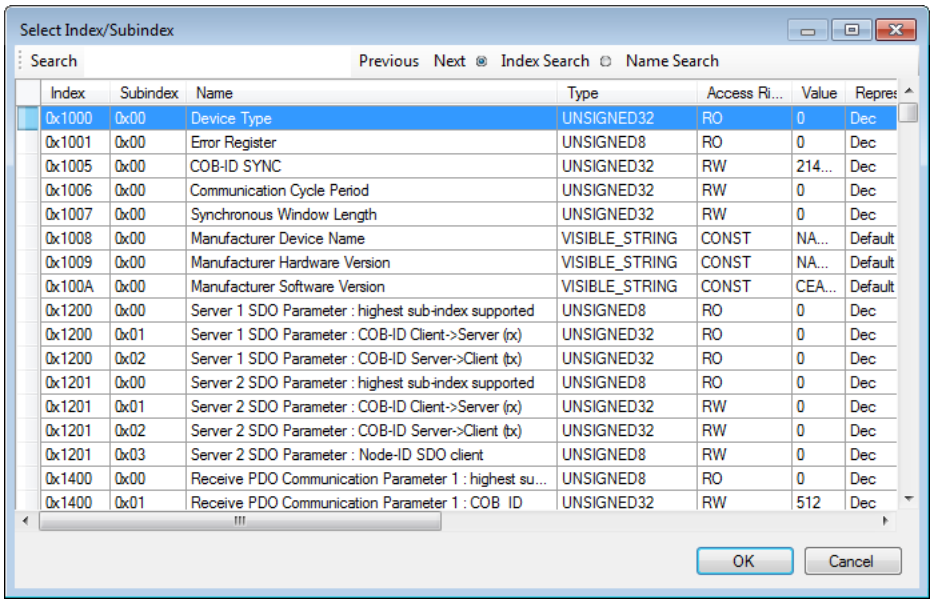
10.1.3 Adding and configuring channels

How to add a new channel:

1. Go to the *trace toolbar* and click the icon.
   The *Channel* dialog box is displayed:



2. In order to select the object, press the **Object Dictionary...** button.
   In the *Select Index/Subindex* dialog box, all available objects of the device are displayed:



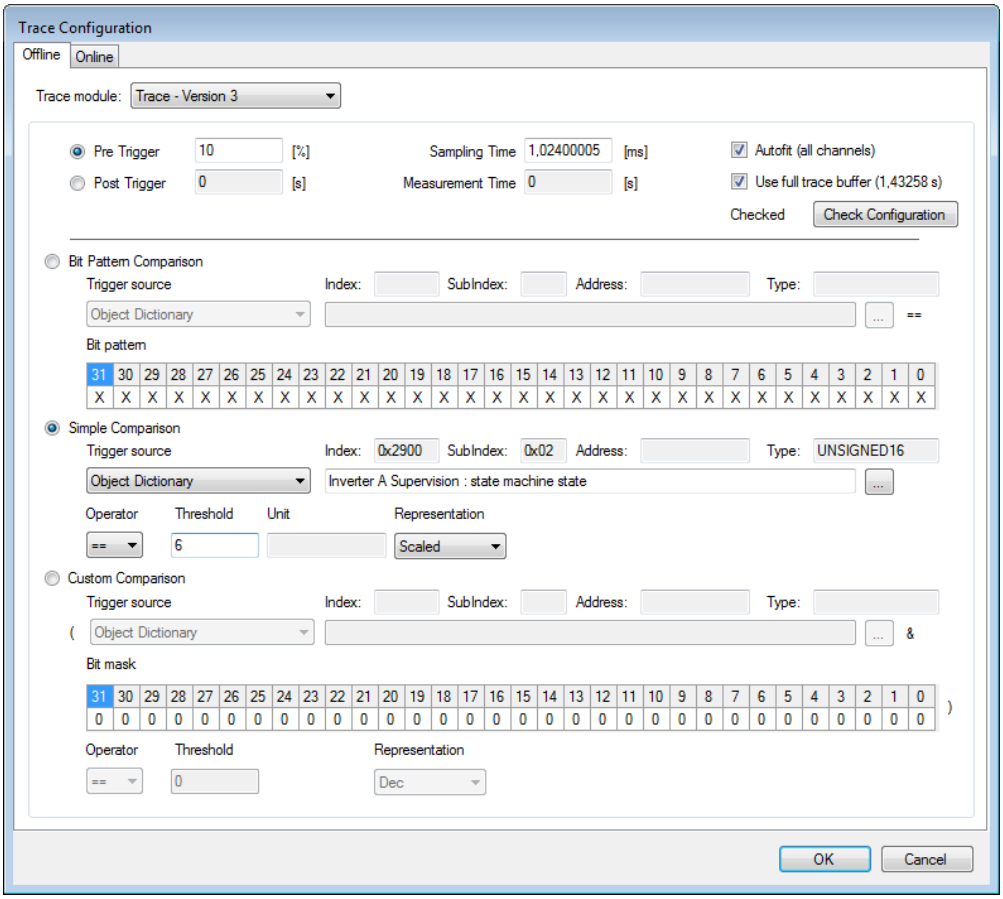
3. Select the object for the new channel in the list field.
4. Click **OK** to accept the selection and close the *Select Index/Subindex* dialog box again.
5. Optional: Make further settings in the *Channel* dialog box for representing the trace.
6. Click **OK** to add a new channel with the carried-out configuration and close the *Channel* dialog box again.

10.1.4 Configuring the trace function

The **Trace Control → Configuration**... command serves to open the *Trace Configuration* dialog box.

Depending on which trace mode has been selected, the **Offline** or **Online** tab is brought to the front.

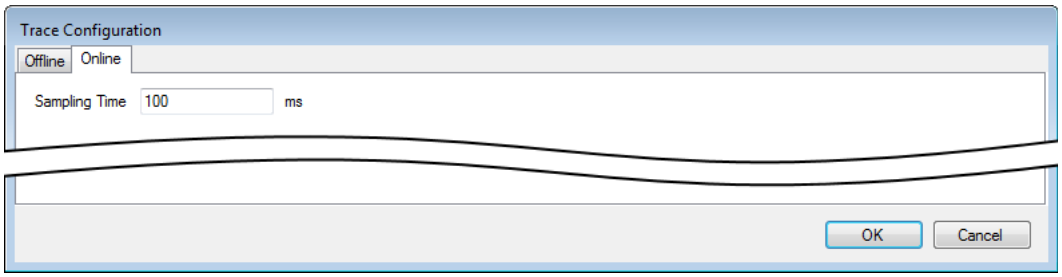
Configuration for "Offline" trace mode



[10-1] Example: trigger setting for trigger start at “Inverter Operation Enable"

setting	Info
Pre/post trigger	Selection of pre or post trigger If both related value are "0", no pre or post trigger is defined.
Sampling time	Time interval for recording
Measurement time	If the **Use full trace buffer** option is not active: Display of the recording time
Autofit	If this option is active, the "Fit" representation option is used for all channels, i.e. the scaling of the Y axis is adapted to the recorded value range.
Use full trace buffer	When this option is active, the entire memory provided in the device is used for the trace function. If you click the **Check Configuration** button, the recording time displayed in the brackets is updated. This depends on the set sampling time, the number of channels and the available memory in the device.
Bit Pattern Comparison Simple Comparison Custom Comparison	Selection of the trigger type and setting of the trigger details: • Trigger source (object) • Bit pattern (for bitter pattern comparison) • Operator and threshold value (for simple numerical comparison).

Configuration for "Online" trace mode



setting	Info
Sampling time	Time interval for recording

10.1.5 Start trace function

After adding one or several channels and configuring the trace function, the trace function can be started via the **Start Online/Offline Trace** command.

- Only the channels ticked in the **Selected** column are recorded.
- After the trace function is completed, you can define by means of the checkmarks which of the recorded channels are to be displayed in the diagram.

10.1.6 Download/upload functions

If you start the trace function in the "offline" trace mode, first the trace configuration is transferred to the MOBILE. This process can also be executed using the **Trace Control → Download Offline Trace Configuration** command.

A trace configuration already stored in the MOBILE vcan be transferred for reuse to the »MOBILE Engineer« using the **Upload Offline Trace Configuration** command.

The **Upload Offline Trace Configuration & Data** command serves to also transfer the trace data to the »MOBILE Engineer« in addition to the trace configuration.

The **Delete Data** command serves to delete the trace data in the MOBILE.

10.1.7 Adapt diagram presentation

The **View** tab represents the trace data in a diagram. The representation can be adapted via the functions described in the following if the trace function is stopped.

Scaling of the Y axis (0 ... 100 %)

The representation of a channel can be quickly changed via the *context menu* (right mouse button) of the channel:

Context menu command	Function
Edit	Open the *Channel* dialog box for configuring the selected channel
Full	Representation mode "Full": 0 % and 100 % represent the lowest and highest value of the data type
Fit	Representation mode "Fit": 0 % and 100 % represent the lowest and highest recorded value
Dec	Display values in decimal representation (default setting)

Context menu command	Function
hex	Display values in hexadecimal representation
Scaled	Display values in the physical unit

Scaling of the time axis

A change in the time base in the **Time/Div** input field serves to expand or compress the representation in terms of time.

The **Diagram Settings → Fit Time** command serves to scale the time axis so that the total trace recording is displayed in the diagram. This is particularly useful after an online trace, as in this trace mode the time axis runs continuously until the trace function is stopped.

Zoom function

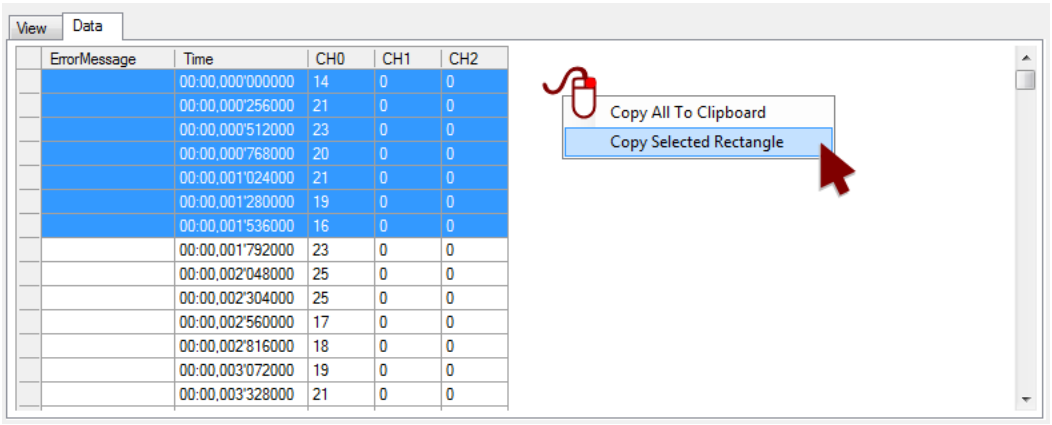
The zoom function serves to enlarge any area in the diagram. Simply drag the frame around area to be enlarged while keeping the left mouse button pressed.

- By clicking the icon, you can undo the last zoom action.
- By clicking the icon, you go back one zoom level.

10.1.8 Display of the trace data in table form

You can also display the trace data in table form by changing to the **Data** tab.

The *context menu* (right mouse button) serves to copy all data or one selected area of the table into the clipboard:



10.2 Error memory

The error memory integrated in the MOBILE records errors detected by the device non-volatilely in chronological order for diagnostic purposes.

- The error memory can store up to 32 error entries.
- The latest error or the event occurred last is always at the first position.
  - In case of a new event and an already full error memory, all error entries will be checked for their priority. If an error entry is found with the same or lower priority than the current event, the error entry with the lowest priority and the oldest time stamp is deleted and the new event is stored at the first position. Otherwise, the new event will be rejected and not stored.
- The error memory can read out, activated and deactivated any time via Unified Diagnostic Services (UDS).
- The error memory supports the "adding", "updating", and "deleting" of error entries.

10.2.1 Structure of the error entries

In addition to the "Diagnostic Trouble Code" (DTC), further information as e.g. frequency and time of the error are stored in the error memory.

Each error entry has a size of 32 bytes with the following structure:

Byte	Bit	Name	Info
0		DTC Priority	Each "Diagnostic Trouble Code" (DTC) is assigned to an error priority. When a new error is entered, the priority determines which entry is deleted from the error memory if it is already full. The following applies: The higher the number, the lower the priority. Priority 1: • This is the highest priority level which is only used for safety-relevant errors. • As many errors may have the priority level 1 as will fit in the chrono stack. • Errors with priority level 1 can only be deleted by a UDS tester access. Self-healing of these errors is not possible. • Errors of priority level 1 must not be overwritten in the error memory. Priority 2-7: • Errors of this priority level can be deleted from the error memory (self-healing, tester, overwriting). • Errors of this priority level can be overwritten by errors with a higher priority. **Note:** Currently the error priority 2 is used for all error entries.
1 - 3		DTC Number	▸ DTC Number
4		DTC Status	▸ DTC Status Detailed description in ISO 14229-1, appendix D.3.
5	0	Occurrence Flag	Displays the type of entry: 0: Error 1: Note
	1 ... 7	-	Reserved (set to 0)
6 - 7		Original Odometer	Odometer mileage at first occurrence of the error • The odometer mileage is read in via the CAN bus. If it is not available the non-available 0xFFFF identification will be entered. • The resolution is 16 km/bit. It is rounded down. • If the read value exceeds the value range, only the LOW word will be entered.
8 - 9		Most Recent Odometer	Odometer mileage at last occurrence of the error

Byte	Bit	Name	Info
10		Frequency Counter	This counter describes how often the event has occurred. • On the first occurrence, the counter is set to 1. • It is counted up to the value 251. Hence, error detections (0xFF, 0xFE) remain also possible in the error memory. If the error is re-entered, the counter will not be incremented anymore. • The resolution is 1 count/bit.
11		Operation Cycle Counter	At each start of an operating cycle, this counter is incremented if the error is not active. However, incrementation only takes place if after ignition-on (terminal 15) an additional time of *minTimeOpCycle* [s] has elapsed. • On the first occurrence of the event, the starting value is 0. • The counter is reset to 0 if the error is re-entered. • It is counted up to the value 251. Hence, error detections (0xFF, 0xFE) remain also possible in the error memory.
12 - 17		Timestamp	Time of error detection • The error entries are sorted on the basis of the time stamp. The latest error occupies the first position. In case of the same time stamps, the errors are listed according to their order of entry (last entered error occupies the first position). • As the master control does not necessarily provides a system time, the internal elapsed-hour meter time is used.
22 - 31		MC Environment Data	Ambient conditions of the Motor Controller the moment the error occurs ▸ MC Environment Data

10.2.1.1 DTC Number

The 3-byte "Diagnostic Trouble Code" (DTC) specifies the occurred error and is set up according to SAE J1939-73, format version 4.

The Diagnostic Trouble Code includes the

- *Suspect Parameter Number* (SPN) = reference to the affected parameter/error and
- *Failure Mode Identifier* (FMI) = error type.

Suspect Parameter Number (SPN)

The SAE J1939 standard defines *Suspect Parameter Number* (SPN) for many recurring parameters in commercial vehicles. These unambiguous numbers serve to diagnose the components in vehicles of different manufacturers in equal measure.

As the parameters of the MOBILE cannot be mapped by the numbers defined by the SAE J1939 standard, the manufacturer-specific SPN number range (0x7F000 ... 0x7FFFF) is used for the parameters of the MOBILE.

The *Suspect Parameter Number* (SPN) for the MOBILE consists of the following:

Byte 3 (DTC high byte)								Byte 2 (DTC middle byte)								Byte 1 (DTC low byte)							
SPN																			FMI				
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
O	Error code							1	1	1	1	C	E	D		1	1	1					

Byte	Bit	Name	Info
1	5 - 7	-	All bits are permanently set to "1".
2	0 - 1	Device (D)	0: Drive Control Unit (DCU) 1: Power Supply Unit (PSU) 2 ... 3: Reserved
	2	Event (E)	0: Warning 1: Error
	3	Controller (C)	0: Motor Controller (MC) 1: Application Controller (APPC)
	4 - 7	-	All bits are permanently set to "1".
3	0 - 6	Error code	Error code (0 ... 127) of the MC or APPC
	7	Output (O)	0: A 1: B

The *Suspect Parameter Number* (SPN) is given in the following order:

SPN																	
7	6	5	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
1	1	1	1	1	1	1	C	E	D		O	Error code						
0x7F (fix)							0x000 ... 0xFFF											
0x7F000 ... 0x7FFFF																		

Failure Mode Identifier (FMI)

In case of the MOBILE, the FMI 31 is used for all errors, thus all 5 FMI bits are set to "1":

Byte 3 (DTC high byte)								Byte 2 (DTC middle byte)								Byte 1 (DTC low byte)							
SPN																			FMI				
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
																			1	1	1	1	1

FMI 31 means "Not Available Or Condition Exists" and can be used if the respective SPN already describes the error type.

Example

DTC = 0x8FF4FF (MC: OutB motor temperature sensor defective)

Byte 3 (DTC high byte)								Byte 2 (DTC middle byte)								Byte 1 (DTC low byte)							
SPN																			FMI				
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
O	Error code											C	E	D									
1	0	0	0	1	1	1	1	1	1	1	1	0	1	0	0	1	1	1	1	1	1	1	1
0x8F								0xF4								0xFF							
0x8FF4FF																							

- Output (O) = 1 = B
- Error code = 0b1111 = 15
- Controller (C) = 0 = Motor Controller (MC)
- Event (E) = 1 = error
- Device (D) = 0b00 = Drive Control Unit (DCU)
- *Suspect Parameter Number* (SPN) =

SPN																			
7	6	5	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	
1	1	1	1	1	1	1	0	1	0	0	1	0	0	0	1	1	1	1	
0x7F (fix)								0x4			0x8F								
0x7F48F																			

10.2.1.2 DTC Status

Detailed description in ISO 14229-1, appendix D.3.

Bit	Description	Init (startup)	Clear Diagnostic Information (UDS)	Self Healing	Chrono-Stack Overflow (Replace)	Test failed	Test passed
0	Error has occurred	0*	0	-	-	1	0
1	Error has occurred since device start	0	0	-	-	1	-
2	not supported	-	-	-	-	-	-
3	Error stored (here already when occurred first), error can also be inactive by now.	from Flash	0	0	0	1	-
4	not supported	-	1	-	-	0	0
5	Error has occurred since the last call of Clear Diagnostic Information (UDS)	from Flash	0	-	-	1	-
6	not supported	1	1	-	-	0	0
7	not supported	-	-	-	-	-	-

* deviating from ISO 14229-1

10.2.1.3 MC Environment Data

The ambient conditions represent the system the moment the error occurs. They can be relevant for the evaluation of the errors occurred. In case of the Motor Controller, 8 bytes are provided for the ambient conditions if an error occurs. If not all bits or bytes are used, unused bits or bytes are set to 0.

Environment data DCU (inverter)

Byte	Bit	Name	Info
1		volDcLink	Current DC-bus voltage (-10 ... 1014 V)
2		curSAct	Current stator current (-10 ... 502 A)
3	0	bVolDLimited	Status of id controller 0: No limitation 1: Limitation is active
	1	bVolQLimited	Status of iq controller 0: No limitation 1: Limitation is active
	2	bCurDLimited	Status of stator current limiter in d direction 0: No limitation 1: Limitation is active
	3	bCurQLimited	Status of stator current limiter in q direction 0: No limitation 1: Limitation is active
	4	bTorqueLimited	Status of speed controller 0: No limitation 1: Limitation is active
	5	bTorqueLimited2	Status of speed controller 2 0: No limitation 1: Limitation is active
	6	bFreqCurLimited	Status of frequency controller 0: No limitation 1: Limitation is active
	7	bVolLimited	Status of voltage limiter 0: No limitation 1: Limitation is active
4	0	bDcVolLimiterActive	Status of DC-bus controller 0: No limitation 1: Limitation is active
	1	bVelocityLimited	Status of position controller 0: No limitation 1: Limitation is active
	2	bFieldWeakened	Status of field weakening controller 0: No limitation 1: Limitation is active
	3 - 7	-	Reserved
5 - 6		statusword	Device status (CiA402 status word)
7 - 8		function control	Status of different functions

Environment data PSU (onboard converter)

Byte	Bit	Name	Info
1		volDcLink	Current DC-bus voltage (-10 ... 1014 V)
2		currentSecondary	Current secondary current (-10 ... 502 A)
3 - 4		-	Reserved
5 - 6		statusword	Device status (CiA402 status word)
7 - 8		-	Reserved

10.2.2 Diagnostic Trouble Codes (DTC)

DTC	Error text	Device	Event	Possible cause	Possible remedy
0x02F0FF	MC: OutA event buffer is full and has missed at least one event	DCU	Warning	• Too many communication faults on the Private CAN. • Too many errors in the MC error memory.	• Correct the communication faults on Private CAN. • Eliminate the error in the MC.
0x02F1FF	MC: OutA event buffer is full and has missed at least one event	PSU	Warning	• Too many communication faults on the Private CAN. • Too many errors in the MC error memory.	• Correct the communication faults on Private CAN. • Eliminate the error in the MC.
0x02F8FF	APPC: OutA watchdog reset occurred	DCU	Warning	The reset module was not triggered by the software.	Restart the software. If the error occurs repeatedly, replace the device.
0x02F9FF	APPC: OutA watchdog reset occurred	PSU	Warning	The reset module was not triggered by the software.	Restart the software. If the error occurs repeatedly, replace the device.
0x03F4FF	MC: OutA power module over current detected by hardware	DCU	Fault	Short circuit in the motor or the motor was switched on in an uncontrolled manner during rotating operation.	Check cable and motor for short circuit.
0x03F5FF	MC: OutA current offset calibration failed	PSU	Fault	• Internal current sensor or measuring circuit is defective. • EMC interferences.	• Replace device. • Eliminate EMC interferences.
0x03FCFF	APPC: OutA hardware/software compatibility not given	DCU	Fault	A wrong software version was loaded.	Load the correct software version.
0x03FDFF	APPC: OutA hardware/software compatibility not given	PSU	Fault	A wrong software version was loaded.	Load the correct software version.
0x04F4FF	MC: OutA power module current offset calibration failed	DCU	Fault	• Current sensor or measuring circuit is defective. • EMC interferences.	• Replace device. • Eliminate EMC interferences.
0x04F5FF	MC: OutA output over current detected by hardware	PSU	Fault	• Short circuit in the DC/DC converter. • Short circuit in the LV on-board supply system.	• Replace device. • Check LV on-board supply system for overload and short circuit.
0x05F4FF	MC: OutA power module temperature sensor defective	DCU	Fault	The thermal sensor in the power section has a short circuit or is interrupted.	Replace device.
0x05F5FF	MC: OutA power module temperature sensor defective	PSU	Fault	The thermal sensor in the DC/DC converter has a short circuit or is interrupted.	Replace device.
0x06F0FF	MC: OutA power module temperature has reached warning level	DCU	Warning	Cooling is insufficient or missing.	Check cooling circuit.
0x06F1FF	MC: OutA power module temperature has reached warning level	PSU	Warning	Cooling is insufficient or missing.	Check cooling circuit.
0x06FCFF	APPC: OutA MC has reset (watchdog or reset chip)	DCU	Fault	The reset module was not triggered by the software.	Restart the software. If the error occurs repeatedly, replace the device.

DTC	Error text	Device	Event	Possible cause	Possible remedy
0x06FDFF	APPC: OutA MC has reset (watchdog or reset chip)	PSU	Fault	The reset module was not triggered by the software.	Restart the software. If the error occurs repeatedly, replace the device.
0x07F4FF	MC: OutA power module temperature has reached error level	DCU	Fault	Cooling is insufficient or missing.	Check cooling circuit.
0x07F5FF	MC: OutA power module temperature has reached error level	PSU	Fault	Cooling is insufficient or missing.	Check cooling circuit.
0x07FCFF	APPC: OutA Fault over FlexIn fault reaction "Quick Stop"	DCU	Fault	External error.	Check system.
0x07FDFF	APPC: OutA Fault over FlexIn fault reaction "Quick Stop"	PSU	Fault	External error.	Check system.
0x08F4FF	MC: OutA power module i*t load error	DCU	Fault	Inverter A is overloaded.	Check load.
0x08F5FF	MC: OutA transformer core temperature sensor defective	PSU	Fault	The thermal sensor in the transformer has a short circuit or is interrupted.	Replace device.
0x08FCFF	APPC: OutA Fault over FlexIn fault reaction "Coast to Stop"	DCU	Fault	External error.	Check system.
0x08FDFF	APPC: OutA Fault over FlexIn fault reaction "Coast to Stop"	PSU	Fault	External error.	Check system.
0x09F1FF	MC: OutA transformer core temperature has reached warning level	PSU	Warning	The temperature of the transformer has exceeded the warning threshold because cooling is insufficient or missing.	Check cooling circuit.
0x09F4FF	MC: OutA power module over current detected by software	DCU	Fault	• Short circuit in the motor. • The switched off and still rotating motor was switched on in an uncontrolled manner.	• Check motor for short circuit. • Check motor cable.
0x09FCFF	APPC: OutA calibration data parameterization failed	DCU	Fault	Interferences on the Private CAN bus.	Check Private CAN bus.
0x09FDFF	APPC: OutA calibration data parameterization failed	PSU	Fault	Interferences on the Private CAN bus.	Check Private CAN bus.
0x0AF0FF	MC: OutA power module pattern data inconsistency	DCU	Warning	The software is overloaded due to the calculating time.	Restart the software. If the error occurs repeatedly, contact Bucher.
0x0AF5FF	MC: OutA transformer core temperature has reached error level	PSU	Fault	The temperature of the transformer has exceeded the switch-off threshold because cooling is insufficient or missing.	Check cooling circuit.
0x0AFCFF	APPC: OutA calibration data invalid	DCU	Fault	Hardware is defective.	Replace device.
0x0AFDFF	APPC: OutA calibration data invalid	PSU	Fault	Hardware is defective.	Replace device.
0x0BF4FF	MC: OutA dc link over voltage detected by hardware	DCU	Fault	Overvoltage in the DC bus.	Check DC bus voltage.
0x0BF5FF	MC: OutA output voltage too low detected by software	PSU	Fault	Overload or short circuit in the LV on-board supply system.	Check LV on-board supply system.

DTC	Error text	Device	Event	Possible cause	Possible remedy
0x0BF8FF	APPC: OutA Flex Out invalid state	DCU	Warning	Connections FLX_OUTx: • Short circuit between connection pins. • Short circuit against terminals 30 or 31.	Check wiring.
0x0BF9FF	APPC: OutA Flex Out invalid state	PSU	Warning	Connections FLX_OUTx: • Short circuit between connection pins. • Short circuit to terminals 30 or 31.	Check wiring.
0x0CF4FF	MC: OutA dc link over voltage detected by software	DCU	Fault	Overvoltage in the DC bus.	Check DC bus voltage.
0x0CF5FF	MC: OutA output voltage too high detected by hardware	PSU	Fault	In the LV on-board supply system, an overvoltage was detected at X21.	• Check LV on-board supply system. • Avoid overvoltage by external supply. • Reduce load shedding.
0x0DF4FF	MC: OutA dc link undervoltage detected by software	DCU	Fault	The voltage in the DC bus is below the set threshold.	Check DC bus voltage and set threshold.
0x0DF5FF	MC: OutA dc link over voltage detected by hardware	PSU	Fault	Overvoltage in the DC bus.	Check DC bus voltage.
0x0EF4FF	MC: OutA fault of the other inverter on the same device	DCU	Fault	The inverter for motor B has a fault.	Eliminate fault in inverter for motor B or deactivate its monitoring.
0x0FF4FF	MC: OutA motor temperature sensor defective	DCU	Fault	The thermal motor sensor has a short circuit or is interrupted.	Check thermal motor sensor and replace it if necessary.
0x10F0FF	MC: OutA motor temperature has reached warning level	DCU	Warning	• Motor cooling is insufficient or missing. • The motor is overloaded by mechanical blocking.	• Check cooling. • Remove blocking of the motor.
0x10F5FF	MC: OutA dc link over voltage detected by software	PSU	Fault	Overvoltage in the DC bus.	Check DC bus voltage.
0x11F4FF	MC: OutA motor temperature has reached error level	DCU	Fault	• Motor cooling is insufficient or missing. • The motor is overloaded by mechanical blocking.	• Check cooling. • Remove blocking of the motor.
0x11F5FF	MC: OutA dc link undervoltage detected by software	PSU	Fault	The voltage in the DC bus is below the set threshold.	Check DC bus voltage and set threshold.
0x12F4FF	MC: OutA motor stator frequency too high	DCU	Fault	• Wrong setpoint selection. • Set limit value too low.	• Check setpoint selection. • Check limit value.
0x12F5FF	MC: OutA board supply voltage error	PSU	Fault	• Unstable LV on-board supply system. • Poor contacting of terminals 30 and 31. • Short circuit on feedback plug. • Defective device.	• Check LV on-board supply system. • Check contacting of terminals 30 and 31 on the device. • Check feedback plug. • Replace device.

DTC	Error text	Device	Event	Possible cause	Possible remedy
0x13F1FF	MC: OutA interlock open due to open cover sheet	PSU	Warning	• Light sensor for detecting the housing cover is soiled. • Housing cover is soiled. • Housing cover is missing or mounted incorrectly.	• Clean light sensor or housing cover. • Mount housing cover correctly.
0x13F4FF	MC: OutA board supply voltage error	DCU	Fault	• Unstable LV on-board supply system. • Poor contacting of terminals 30 and 31. • Short circuit on feedback plug. • Defective device.	• Check LV on-board supply system. • Check contacting of terminals 30 and 31 on the device. • Check feedback plug. • Replace device.
0x13FCFF	APPC: OutA KL30 fault detected	DCU	Fault	Overvoltage in the on-board supply system.	Check on-board supply system.
0x13FDFF	APPC: OutA KL30 fault detected	PSU	Fault	Overvoltage in the on-board supply system.	Check on-board supply system.
0x14F4FF	MC: OutA receive PDO timeout	DCU	Fault	Private CAN receive messages are not sent cyclically or are not received by the MC.	Check Private CAN communication (e.g. if terminating resistor 120 ohm is missing).
0x14F5FF	MC: OutA task calculation time overrun	PSU	Fault	The calculating time in the MC is insufficient and a task overflow has occurred.	Check parameterisation.
0x14FCFF	APPC: OutA no valid dataset found	DCU	Fault	The device data set is incorrect or not available.	Download device data set.
0x14FDFF	APPC: OutA no valid dataset found	PSU	Fault	The device data set is incorrect or not available.	Download device data set.
0x15F4FF	MC: OutA NMT not in state operational	DCU	Fault	• Wrong NMT commands are sent by an external user via Private CAN. • The APPC does not send any NMT commands.	Check Private CAN communication.
0x15F5FF	MC: OutA system error, analog input or motor feedback DMA error	PSU	Fault	Internal software error.	Hardware is defective, replace device.
0x15FCFF	APPC: OutA spi intercom failed	DCU	Fault	The internal SPI communication between APPC and MC is faulty.	Hardware is defective, replace device.
0x15FDFF	APPC: OutA spi intercom failed	PSU	Fault	The internal SPI communication between APPC and MC is faulty.	Hardware is defective, replace device.
0x16F4FF	MC: OutA task calculation time overrun	DCU	Fault	The calculating time in the MC is insufficient and a task overflow has occurred.	Check parameterisation.
0x16F5FF	MC: OutA receive PDO timeout	PSU	Fault	Private CAN receive messages are not sent cyclically or are not received by the MC.	Check Private CAN communication (e.g. if terminating resistor 120 W is missing).
0x16FCFF	APPC: OutA MC firmware download failed	DCU	Fault	• Interferences on the Private CAN bus. • Software is faulty.	• Check Private CAN bus. • Update software.
0x16FDFF	APPC: OutA MC firmware download failed	PSU	Fault	• Interferences on the Private CAN bus. • Software is faulty.	• Check Private CAN bus. • Update software.
0x17F4FF	MC: OutA net synchronisation error	DCU	Fault	• Mains voltage or frequency in the impermissible range. • Faulty wiring of mains voltage measurement.	• Check voltage supply system. • Check wiring of the mains voltage measurement.

DTC	Error text	Device	Event	Possible cause	Possible remedy
0x17F5FF	MC: OutA NMT not in state operational	PSU	Fault	• Wrong NMT commands are sent by an external user via Private CAN. • The APPC does not send any NMT commands.	Check Private CAN communication.
0x17FCFF	APPC: OutA MC firmware start failed	DCU	Fault	• Interferences on the Private CAN bus. • Software is faulty.	• Check Private CAN bus. • Update software.
0x17FDFF	APPC: OutA MC firmware start failed	PSU	Fault	• Interferences on the Private CAN bus. • Software is faulty.	• Check Private CAN bus. • Update software.
0x18F4FF	MC: OutA position device signal too low	DCU	Fault	• Interference in the position encoder. • Position encoder is wired incorrectly. • Voltage supply for the position encoder has been set incorrectly.	• Check position encoder and replace it if necessary. • Check wiring. • Set voltage supply correctly.
0x18F5FF	MC: OutA ambient temperature sensor defective	PSU	Fault	The thermal sensor for the temperature inside the device has a short circuit or is interrupted.	Replace device.
0x18FCFF	APPC: OutA Parameterization failed	DCU	Fault	• Interferences on the Private CAN bus. • Device data set is faulty.	• Check Private CAN bus. • Update device data set.
0x18FDFF	APPC: OutA Parameterization failed	PSU	Fault	• Interferences on the Private CAN bus. • Device data set is faulty.	• Check Private CAN bus. • Update device data set.
0x19F1FF	MC: OutA ambient temperature has reached warning level	PSU	Warning	Cooling inside the device is insufficient or missing.	Check cooling.
0x19F4FF	MC: OutA position device signal too high	DCU	Fault	• Interference in the position encoder. • Position encoder is wired incorrectly. • Voltage supply for the position encoder has been set incorrectly.	• Check position encoder and replace it if necessary. • Check wiring. • Set voltage supply correctly.
0x19F8FF	APPC: OutA public CAN receive msg timeout	DCU	Warning	Public CAN receive messages are not sent cyclically or are not received by the device.	Check Public CAN communication.
0x19F9FF	APPC: OutA public CAN receive msg timeout	PSU	Warning	Public CAN receive messages are not sent cyclically or are not received by the device.	Check Public CAN communication.
0x1AF4FF	MC: OutA resolver calibration failed	DCU	Fault	Poor resolver signal due to defective contacting or wrong installation.	Install or wire resolver correctly.
0x1AF5FF	MC: OutA ambient temperature has reached error level	PSU	Fault	Cooling inside the device is insufficient or missing.	Check cooling.
0x1AF8FF	APPC: OutA private CAN receive PDO timeout	DCU	Warning	Private CAN receive messages are not sent cyclically or are not received by the device.	Check Private CAN communication (e.g. if terminating resistor 120 W is missing).
0x1AF9FF	APPC: OutA private CAN receive PDO timeout	PSU	Warning	Private CAN receive messages are not sent cyclically or are not received by the device.	Check Private CAN communication (e.g. if terminating resistor 120 W is missing).
0x1BF1FF	MC: OutA dc link ripple voltage too high	PSU	Warning	The AC component in the DC bus is too high.	Check DC-bus connection for oscillations.
0x1BF4FF	MC: OutA system error, analog input or motor feedback DMA error	DCU	Fault	Hardware is defective.	Replace device.

DTC	Error text	Device	Event	Possible cause	Possible remedy
0x1BF8FF	APPC: OutA invalid setpoint(s) received	DCU	Fault	The setpoints of the master control are faulty.	Check setpoint ranges.
0x1BF9FF	APPC: OutA invalid setpoint(s) received	PSU	Fault	The setpoints of the master control are faulty.	Check setpoint ranges.
0x1CF0FF	MC: OutA interlock open due to open cover sheet	DCU	Warning	• Light sensor for detecting the housing cover is soiled • Housing cover is soiled. • Housing cover is missing or mounted incorrectly.	• Clean light sensor or housing cover. • Mount housing cover correctly.
0x1CF5FF	MC: OutA a negative output voltage is detected by software	PSU	Fault	The LV on-board supply system is connected with reverse polarity.	Check LV on-board supply system and remove polarity reversal.
0x1CF8FF	APPC: OutA spi wuc intercom read failed	DCU	Fault	Hardware is defective.	Replace device.
0x1CF9FF	APPC: OutA spi wuc intercom read failed	PSU	Warning	Hardware is defective.	Replace device.
0x1DF1FF	MC: OutA plug cover sensor signal low	PSU	Warning	The light sensor for detecting the housing cover is soiled.	Clean light sensor.
0x1DF4FF	MC: OutA gate driver disabled by APPC	DCU	Fault	• Initialisation error in the APPC. • The firmware is not compatible with the hardware. • The parameter set is not compatible with the firmware.	• Check Private CAN communication. • Use correct firmware. • Use correct parameter set.
0x1DFCFF	APPC: OutA spi wuc intercom config failed	DCU	Fault	Hardware is defective.	Replace device.
0x1DFDFF	APPC: OutA spi wuc intercom config failed	PSU	Fault	Hardware is defective.	Replace device.
0x1EF1FF	MC: OutA power module i*t load has reached warning level	PSU	Warning	The power section is overloaded.	Check load.
0x1EF4FF	MC: OutA motor stall error	DCU	Fault	• The stalling torque of the sensorless motor has been exceeded. • The controller parameters are not correct.	• Check motor load. • Check parameterisation.
0x1EFCFF	APPC: OutA spi wuc intercom sleep failed	DCU	Fault	Hardware is defective.	Replace device.
0x1EFDFF	APPC: OutA spi wuc intercom sleep failed	PSU	Fault	Hardware is defective.	Replace device.
0x1FF0FF	MC: OutA ambient temperature has reached warning level	DCU	Warning	Cooling inside the device is insufficient or missing.	Check cooling.
0x1FF5FF	MC: OutA power module i*t load error	PSU	Fault	The power section is overloaded.	Check load.
0x1FF8FF	APPC: OutA public CAN short circuit	DCU	Warning	Short circuit in the CAN network.	Check CAN wiring.
0x1FF9FF	APPC: OutA public CAN short circuit	PSU	Warning	Short circuit in the CAN network.	Check CAN wiring.
0x20F4FF	MC: OutA ambient temperature has reached error level	DCU	Fault	Cooling inside the device is insufficient or missing.	Check cooling.
0x20F5FF	MC: OutA over current detected by software	PSU	Fault	• Short circuit at terminals X21/B- and X21/B+.	• Check the connections for short-circuit. • Check cable.

DTC	Error text	Device	Event	Possible cause	Possible remedy
0x21F4FF	MC: OutA ambient temperature sensor defective	DCU	Fault	The thermal sensor for the temperature inside the device has a short circuit or is interrupted.	Replace device.
0x21F5FF	MC: OutA gate driver disabled by APPC	PSU	Fault	• Initialisation error in the APPC. • The firmware is not compatible with the hardware. • The parameter set is not compatible with the firmware.	• Check Private CAN communication. • Use correct firmware. • Use correct parameter set.
0x22F4FF	MC: OutA power module clamping timeout	DCU	Fault	The motor current has reached the set switch-off threshold (clamping is performed) and the set timeout for clamping has been exceeded.	• Check parameterisation. • Reduce load.
0x23F0FF	MC: OutA dc link ripple voltage too high	DCU	Warning	The AC component in the DC bus is too high.	Check DC-bus connection for oscillations.
0x24F0FF	MC: OutA motor i^2*t load warning	DCU	Warning	• The motor is overloaded. • The i2×t monitoring (thermal overload protection) is parameterized incorrectly.	• Reduce motor load. • Check the parameterisation of the i2×t monitoring.
0x25F4FF	MC: OutA motor i^2*t load error	DCU	Fault	• The motor is overloaded. • The i2×t monitoring (thermal overload protection) is parameterized incorrectly.	• Reduce motor load. • Check the parameterisation of the i2×t monitoring.
0x26F4FF	MC: OutA motor switched off during active field weakening	DCU	Fault	The motor has been switched off at active field weakening.	Avoid operating error.
0x27F4FF	MC: OutA invalid parameter combination selected	DCU	Fault	Wrong parameter combination (e.g. impermissible combination of activated generator mode and deactivated light sensor).	Check parameters.
0x28F0FF	MC: OutA plug cover sensor signal low	DCU	Warning	The light sensor for detecting the housing cover is soiled.	Clean light sensor.
0x29F4FF	MC: OutA motor connection test failed	DCU	Fault	• Motor not connected. • Motor cable interrupted. • Short circuit in motor cable or motor. • DC link supply interrupted.	• Connect motor. • Check motor cable and motor. • Check DC link supply.
0x2AF0FF	MC: OutA power module i*t load has reached warning level	DCU	Warning	Inverter A is overloaded.	Check load.
0x2BF4FF	MC: OutA isolation fault detected	DCU	Fault	Ground fault of at least one motor phase	Check wiring
0x82F0FF	MC: OutB event buffer is full and has missed at least one event	DCU	Warning	• Communication faults on the Private CAN. • Too many errors in the MC error memory.	• Correct the communication faults on Private CAN. • Eliminate the error in the MC.
0x82F8FF	APPC: OutB watchdog reset occurred	DCU	Warning	The reset module was not triggered by the software.	Restart the software. If the error occurs repeatedly, replace the device.
0x83F4FF	MC: OutB power module over current detected by hardware	DCU	Fault	• Short circuit in the motor. • The switched off and still rotating motor was switched on in an uncontrolled manner.	• Check motor for short circuit. • Check motor cable.

DTC	Error text	Device	Event	Possible cause	Possible remedy
0x83FCFF	APPC: OutB hardware/software compatibility not given	DCU	Fault	A wrong software version was loaded.	Load the correct software version.
0x84F4FF	MC: OutB power module current offset calibration failed	DCU	Fault	• Current sensor or measuring circuit is defective. • EMC interferences.	• Replace device. • Eliminate EMC interferences.
0x85F4FF	MC: OutB power module temperature sensor defective	DCU	Fault	The thermal sensor in the power section has a short circuit or is interrupted.	Replace device.
0x86F0FF	MC: OutB power module temperature has reached warning level	DCU	Warning	Cooling is insufficient or missing.	Check cooling circuit.
0x86FCFF	APPC: OutB MC has reset (watchdog or reset chip)	DCU	Fault	The reset module was not triggered by the software.	Restart the software. If the error occurs repeatedly, replace the device.
0x87F4FF	MC: OutB power module temperature has reached error level	DCU	Fault	Cooling is insufficient or missing.	Check cooling circuit.
0x87FCFF	APPC: OutB Fault over FlexIn fault reaction "Quick Stop"	DCU	Fault	External error.	Check system.
0x88F4FF	MC: OutB power module i*t load error	DCU	Fault	Inverter B is overloaded.	Check load.
0x88FCFF	APPC: OutB Fault over FlexIn fault reaction "Coast to Stop"	DCU	Fault	External error.	Check system.
0x89F4FF	MC: OutB power module over current detected by software	DCU	Fault	• Short circuit in the motor. • The switched off and still rotating motor was switched on in an uncontrolled manner.	• Check motor for short circuit. • Check motor cable.
0x89FCFF	APPC: OutB calibration data parameterization failed	DCU	Fault	Interferences on the Private CAN bus.	Check Private CAN bus.
0x8AF0FF	MC: OutB power module pattern data inconsistency	DCU	Warning	The software is overloaded due to the calculating time.	Restart the software. If the error occurs repeatedly, contact Bucher.
0x8AFCFF	APPC: OutB The calibration data invalid	DCU	Fault	Hardware is defective	Replace device
0x8BF4FF	MC: OutB dc link over voltage detected by hardware	DCU	Fault	Overvoltage in the DC bus.	Check DC bus voltage.
0x8BF8FF	APPC: OutB Flex Out invalid state	DCU	Warning	Connections FLX_OUTx: • Short circuit between connection pins. • Short circuit to terminals 30 or 31.	Check wiring.
0x8CF4FF	MC: OutB dc link over voltage detected by software	DCU	Fault	Overvoltage in the DC bus.	Check DC bus voltage.
0x8DF4FF	MC: OutB dc link undervoltage detected by software	DCU	Fault	The voltage in the DC bus is below the set threshold.	Check DC bus voltage and set threshold.
0x8EF4FF	MC: OutB fault of the other inverter on the same device	DCU	Fault	The inverter for motor A has a fault.	Eliminate fault in inverter for motor A or deactivate its monitoring.

DTC	Error text	Device	Event	Possible cause	Possible remedy
0x8FF4FF	MC: OutB motor temperature sensor defective	DCU	Fault	The thermal motor sensor has a short circuit or is interrupted.	Check thermal motor sensor and replace it if necessary.
0x90F0FF	MC: OutB motor temperature has reached warning level	DCU	Warning	• Motor cooling is insufficient or missing. • The motor is overloaded by mechanical blocking.	• Check cooling. • Remove blocking of the motor.
0x91F4FF	MC: OutB motor temperature has reached error level	DCU	Fault	• Motor cooling is insufficient or missing. • The motor is overloaded by mechanical blocking.	• Check cooling. • Remove blocking of the motor.
0x92F4FF	MC: OutB motor stator frequency too high	DCU	Fault	• Wrong setpoint selection. • Set limit value too low.	• Check setpoint selection. • Check limit value.
0x93F4FF	MC: OutB board supply voltage error	DCU	Fault	• Unstable LV on-board supply system. • Poor contacting of terminals 30 and 31. • Short circuit on feedback plug. • Defective device.	• Check LV on-board supply system. • Check contacting of terminals 30 and 31 on the device. • Check feedback plug. • Replace device.
0x93FCFF	APPC: OutB KL30 fault detected	DCU	Fault	Overvoltage in the on-board supply system.	Check on-board supply system.
0x94F4FF	MC: OutB receive PDO timeout	DCU	Fault	Private CAN receive messages are not sent cyclically or are not received by the MC.	Check Private CAN communication (e.g. if terminating resistor 120 W is missing).
0x94FCFF	APPC: OutB no valid dataset found	DCU	Fault	The device data set is corrupt or missing.	Download device data set.
0x95F4FF	MC: OutB NMT not in state operational	DCU	Fault	• Wrong NMT commands are sent by an external user via Private CAN. • The APPC does not send any NMT commands.	Check Private CAN communication.
0x95FCFF	APPC: OutB spi intercom failed	DCU	Fault	The internal SPI communication between APPC and MC is faulty.	Hardware is defective, replace device.
0x96F4FF	MC: OutB task calculation time overrun	DCU	Fault	The calculating time in the MC is insufficient and a task overflow has occurred.	Check parameterisation.
0x96FCFF	APPC: OutB MC firmware download failed	DCU	Fault	• Interferences on the Private CAN bus. • Software is faulty.	• Check Private CAN bus. • Update software.
0x97F4FF	MC: OutB net synchronisation error	DCU	Fault	• Mains voltage or frequency in the impermissible range. • Faulty wiring of mains voltage measurement.	• Check voltage supply system. • Check wiring of the mains voltage measurement.
0x97FCFF	APPC: OutB MC firmware start failed	DCU	Fault	• Interferences on the Private CAN bus. • Software is faulty.	• Check Private CAN bus. • Update software.
0x98F4FF	MC: OutB position device signal too low	DCU	Fault	• Interference in the position encoder. • Position encoder is wired incorrectly. • Voltage supply for the position encoder has been set incorrectly.	• Check position encoder and replace it if necessary. • Check wiring. • Set voltage supply correctly.
0x98FCFF	APPC: OutB Parameterization failed	DCU	Fault	• Interferences on the Private CAN bus. • Device data set is faulty.	• Check Private CAN bus. • Update device data set.

DTC	Error text	Device	Event	Possible cause	Possible remedy
0x99F4FF	MC: OutB position device signal too high	DCU	Fault	• Interference in the position encoder. • Position encoder is wired incorrectly. • Voltage supply for the position encoder has been set incorrectly.	• Check position encoder and replace it if necessary. • Check wiring. • Set voltage supply correctly.
0x99F8FF	APPC: OutB public CAN receive msg timeout	DCU	Warning	Public CAN receive messages are not sent cyclically or are not received by the device.	Check Public CAN communication.
0x9AF4FF	MC: OutB resolver calibration failed	DCU	Fault	Poor resolver signal due to defective contacting or wrong installation.	Install or wire resolver correctly.
0x9AF8FF	APPC: OutB private CAN receive PDO timeout	DCU	Warning	Private CAN receive messages are not sent cyclically or are not received by the device.	Check Private CAN communication (e.g. if terminating resistor 120 W is missing).
0x9BF4FF	MC: OutB system error, analog input or motor feedback DMA error	DCU	Fault	Hardware is defective.	Replace device.
0x9BF8FF	APPC: OutB invalid setpoint(s) received	DCU	Fault	The setpoints of the master control are faulty.	Check setpoint ranges.
0x9CF0FF	MC: OutB interlock open due to open cover sheet	DCU	Warning	• Light sensor for detecting the housing cover is soiled • Housing cover is soiled. • Housing cover is missing or mounted incorrectly.	• Clean light sensor or housing cover. • Mount housing cover correctly.
0x9CF8FF	APPC: OutB spi wuc intercom read failed	DCU	Warning	Hardware is defective.	Replace device.
0x9DF4FF	MC: OutB gate driver disabled by APPC	DCU	Fault	• Initialisation error in the APPC. • The firmware is not compatible with the hardware. • The parameter set is not compatible with the firmware.	• Check Private CAN communication. • Use correct firmware. • Use correct parameter set.
0x9DFCFF	APPC: OutB spi wuc intercom config failed	DCU	Fault	Hardware is defective.	Replace device.
0x9EF4FF	MC: OutB motor stall error	DCU	Fault	• The stalling torque of the sensorless motor has been exceeded. • The controller parameters are not correct.	• Check motor load. • Check parameterisation.
0x9EFCFF	APPC: OutB spi wuc intercom sleep failed	DCU	Fault	Hardware is defective.	Replace device.
0x9FF0FF	MC: OutB ambient temperature has reached warning level	DCU	Warning	Cooling inside the device is insufficient or missing.	Check cooling.
0x9FF8FF	APPC: OutB public CAN short circuit	DCU	Warning	Short circuit in the CAN network.	Check CAN wiring.
0xA0F4FF	MC: OutB ambient temperature has reached error level	DCU	Fault	Cooling inside the device is insufficient or missing.	Check cooling.
0xA1F4FF	MC: OutB ambient temperature sensor defective	DCU	Fault	The thermal sensor for the temperature inside the device has a short circuit or is interrupted.	Replace device.
0xA2F4FF	MC: OutB power module clamping timeout	DCU	Fault	The motor current has reached the set switch-off threshold (clamping is performed) and the set timeout for clamping has been exceeded.	• Check parameterisation. • Reduce load.

DTC	Error text	Device	Event	Possible cause	Possible remedy
0xA3F0FF	MC: OutB dc link ripple voltage too high	DCU	Warning	The AC component in the DC bus is too high.	Check DC-bus connection for oscillations.
0xA4F0FF	MC: OutB motor i^2*t load warning	DCU	Warning	• The motor is overloaded. • The i2×t monitoring (thermal overload protection) is parameterized incorrectly.	• Reduce motor load. • Check the parameterisation of the i2×t monitoring.
0xA5F4FF	MC: OutB motor i^2*t load error	DCU	Fault	• The motor is overloaded. • The i2×t monitoring (thermal overload protection) is parameterized incorrectly.	• Reduce motor load. • Check the parameterisation of the i2×t monitoring.
0xA6F4FF	MC: OutB motor switched off during active field weakening	DCU	Fault	The motor has been switched off at active field weakening.	Avoid operating error.
0xA7F4FF	MC: OutB invalid parameter combination selected	DCU	Fault	Wrong parameter combination (e.g. impermissible combination of activated generator mode and deactivated light sensor).	Check parameters.
0xA8F0FF	MC: OutB plug cover sensor signal low	DCU	Warning	The light sensor for detecting the housing cover is soiled.	Clean light sensor.
0xA9F4FF	MC: OutB motor connection test failed	DCU	Fault	• Motor not connected. • Motor cable interrupted. • Short circuit in motor cable or motor.	• Connect motor. • Check motor cable and motor.
0xAAF0FF	MC: OutB power module i*t load has reached warning level	DCU	Warning	Inverter B is overloaded.	Check load.
0xABF4FF	MC: OutB isolation fault detected	DCU	Fault	Ground fault of at least one motor phase.	Check wiring.

10.2.3 Delete error entries

Deleting an error entry can be triggered by the following actions:

- External delete/reset request for a single "Diagnostic Trouble Code" (DTC) via tester tool (Unified Diagnostic Services: $14: Clear Diagnostic Information)
- Self-healing of the corresponding error (currently not yet implemented)

10.3 SAE J1939 Diagnostic Messages (DM)

The diagnostics scope is described in the SAE J1939-73 standard (Application Layer - Diagnostics). The diagnostic messages DM1 - DM52 are largely based on the on-board diagnostics OBD (ISO 15031/J1979) which is used in the passenger car field for diagnostics during driving operation.

The on-board diagnostics (J1939 in the commercial vehicle field and J1979 for the passenger cars) for emission-relevant systems are mandated by law. Hence, this is not mandatory for the MOBILE. However, the MOBILE supports the J1939 diagnostic message DM1 for error messaging to the master control during driving operation.

10.3.1 DM1 - Active Diagnostic Trouble Codes

The diagnostics message DM1 serves to transmit all currently pending errors and the status of the error and warning lamps cyclically. If no errors are active, the message is still transmitted cyclically.

Note!

In the default setting, the cyclic transmission of the diagnostics message DM1 is deactivated. The setting "1" in the 0x4020:0x20 object activates the cyclic transmission.

Transport protocol

The length of the message (data bytes) varies with the number of active errors. As soon as more than 8 bytes are to be transmitted via CAN, a transport protocol is required. As the message is not intended for a certain receiver, the transport protocol BAM (Broadcast Announce Message) is used which only goes into one direction.

Structure of the diagnostics message

CAN-ID		Cycle time	Transmitter	Receiver
0x18FECAyy	Prio: 6, PGN: 65226, SA: yy	1000 ms (or in case of DTC status change)	yy	All

Byte	Bit	Name	Value range	Info
0	0 ... 1	Protect Lamp Status	0 ... 3	Lamp states: 0: Lamp off 1: Lamp on
	2 ... 3	Amber Warning Lamp Status	0 ... 3	
	4 ... 5	Red Stop Lamp Status	0 ... 3	
	6 ... 7	Malfunction Indicator Lamp Status	0 ... 3	
1		Lamp Flashing	Always 0xFF	Not implemented
2		DTC high byte	0x000000 ... 0xFFFFFF A list of all MOBILE DTCs can be found in the chapter "Diagnostic Trouble Codes (DTC)"	Diagnostic Trouble Code (DTC) DTC Number of the first active error or 0x000000 if no error is active.
3		DTC middle byte		
4		DTC low byte		
5	0 ... 6	Occurrence Count	0 ... 126 (127 = not available)	Number of how often the error has occurred.
	7	SPN Conversion Method	always 0	Conversion according to SAE J1939-73, format version 4
6 - 7		-	0x0000 ... 0xFFFF	The first DTC bytes of the next active error or 0xFFFF if only one or no error is active.

Structure of the diagnostics message in case of several active errors

The following example shows the structure of the diagnostics message in case of three active errors:

Byte 0	1	2	3	4	5	6	7	8	9	10	11	12	13
Lamp states	0xFF	DTC (1)			Occurrence Count (1)	DTC (2)			Occurrence Count (2)	DTC (3)			Occurrence Count (3)

Lamp states

The lamp states result from the current states (active/passive) of all errors/monitoring procedures supported by control device. Thus, the states of all errors are summarised in only 4 lamps. In the vehicle, the lamp states are summarised from the DM1 messages of all control devices and displayed on the dashboard.

The respective lamps can be configured per inverter output and error type. Hence, the lamps cannot be freely configured for each error but for each error type.

The following error types are distinguished:

Error type	Description
Fault	Inverter is definitely switched off, a restart is only possible via terminal 15.
Temporary error	Inverter is switched off, automatic restart is active.
Warning	Warning sign, does not switch off the inverter, derating might be active.

The configuration is carried out in a bit-coded manner. The assignment of an error type to a lamp is made by setting the corresponding bit to "1". In the default setting, no lamp has been configured yet.

Lamp	Assignment of error type to lamp						
		Warning		Temporary error		Fault	
		Inverter B	Inverter A	Inverter B	Inverter A	Inverter B	Inverter A
		Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Protect Lamp	0x4020:0x21	0	0	0	0	0	0
Amber Warning Lamp	0x4020:0x22	0	0	0	0	0	0
Red Stop Lamp	0x4020:0x23	0	0	0	0	0	0
Malfunction Indicator Lamp	0x4020:0x24	0	0	0	0	0	0

10.4 Meaning of the warning and error bits in the MC status word 1 & 2

MC status word 1

Bit	Meaning in case of DCU (inverter)		Meaning in case of PSU (onboard converter)	
	Diagnostic parameter: 0x2900:0x05 - Inverter A Supervision: latched status 1 0x3100:0x05 - Inverter B Supervision: latched status 1	*	Diagnostic parameter: 0x2900:0x05 - DC Converter Supervision: latched status 1	*
0	Since the last upload, there is a new entry in the event memory.	0	Since the last upload, there is a new entry in the event memory.	0
1	Event memory is full, at least one entry got lost.	0	Event memory is full, at least one entry got lost.	0
2	Power section: Hardware has detected overcurrent.	1	Current offset calibration has failed.	1
3	Power section: Current offset calibration has failed.	1	Hardware has detected a too high output current.	1
4	Power section: Thermal sensor is defective.	1	Thermal sensor 1 is defective.	1
5	Power section: Temperature has reached warning threshold.	0	Temperature 1 has reached warning threshold.	0
6	Power section: Temperature has reached error threshold.	1	Temperature 1 has reached error threshold.	1
7	Power section: Ixt overload	1	Thermal sensor 2 is defective.	1
8	Power section: Firmware has detected overcurrent.	1	Temperature 2 has reached warning threshold.	0
9	Power section: Inconsistent PWM pattern.	0	Temperature 2 has reached error threshold.	1
10	DC bus: Hardware has detected overvoltage.	1	Firmware has detected insufficient output voltage.	1
11	DC bus: Firmware has detected overvoltage.	1	Hardware has detected a too high output voltage.	1
12	DC bus: Firmware has detected undervoltage.	1	DC bus: Hardware has detected overvoltage.	1
13	There is a fault in the other inverter in the MOBILE.	1	Reserved	
14	Motor thermal sensor is defective.	1	Reserved	
15	Motor temperature has reached warning threshold.	0	DC bus: Firmware has detected overvoltage.	1
16	Motor temperature has reached error threshold.	1	DC bus: Firmware has detected undervoltage.	1
17	Motor stator frequency is too high.	1	Voltage supply of the MOBILE has failed or is interrupted.	1
18	Voltage supply of the MOBILE has failed or is interrupted.	1	MOBILE cover is open (InterLock).	0
19	No PDO has been received (time-out).	1	Program time overflow	1
20	Network management (NMT) is not in "Operational" state.	1	System error, error in analog inputs or motor feedback.	1
21	Program time overflow	1	No PDO has been received (time-out).	1
22	Mains synchronisation error	1	Network management (NMT) is not in "Operational" state.	1
23	Position encoder signal too weak.	1	MOBILE interior thermal sensor is defective.	1
24	Position encoder signal is too strong.	1	MOBILE interior temperature has reached warning threshold.	0
25	Resolver calibration has failed.	1	MOBILE interior temperature has reached error threshold.	1
26	System error, error in analog inputs or motor feedback.	1	Too high superimposed AC voltage in the DC bus.	0
27	MOBILE cover is open (InterLock).	0	A negative output voltage has been detected.	1
28	Power section has been locked by the Application Controller.	1	MOBILE cover: sensor signal too weak.	0
29	Tilt monitoring has detected blocked motor	1	Power section: utilisation I×t has reached the warning threshold.	0
30	MOBILE interior temperature has reached warning threshold.	0	Power section: utilisation I×t has reached the error threshold.	1
31	MOBILE interior temperature has reached error threshold.	1	Firmware has detected overcurrent.	1

* Response: 0 = warning, 1 = error

MC status word 2

Bit	Meaning in case of DCU (inverter)		Meaning in case of PSU (onboard converter)	
	Diagnostic parameter: 0x2900:0x07 - Inverter A Supervision: latched status 1 0x3100:0x07 - Inverter B Supervision: latched status 2	*	Diagnostic parameter: 0x2900:0x07 - DC Converter Supervision: latched status 1	*
0	MOBILE interior thermal sensor is defective.	1	Power section has been locked by the application controller.	1
1	Power section: Clamping time-out	1	Reserved	
2	Too high superimposed AC voltage in the DC bus.	0	Reserved	
3	Motor utilisation (I2xt) has reached warning threshold.	0	Reserved	
4	Motor utilisation (I2xt) has reached error threshold.	1	Reserved	
5	Motor was switched off upon active field weakening.	1	Reserved	
6	Invalid combination of parameters selected	1	Reserved	
7	MOBILE cover sensor: signal too weak	1	Reserved	
8	Motor connection test has failed	1	Reserved	
9	Power section utilisation (Ixt) has reached the warning threshold	0	Reserved	
10 ... 15	Reserved		Reserved	

* Response: 0 = warning, 1 = error

10.5 Error messages, causes & and possible remedies

The object 0x4003 displays the current error code of the Application Controller (APPC).

Possible error codes

Value	Meaning/cause(s)	Possible remedies	LED1
0	No error		○
1	Invalid CAN address (offset)	Check wiring of the ID pins (X31). ▸ Device identification (📖 18)	(((●)))
2	Device error	Mains switching • Please contact Bucher if the problem occurs again.	○
3	Hardware/firmware are incompatible		●
	Type code data was not written during start, or was written incorrectly	Restart MOBILE.	
	The firmware is not compatible with the hardware	Load compatible firmware	
4	Initialisation of the flash disk has failed		(((●)))
5	The boot loader/firmware are incompatible	Use current boot loader version	(●)
6	The MC has been reset	Contact Bucher	●
19	The voltage at terminal KL30 is 60 V		●
20	No or invalid data record		●
	No data record has been found.		
	Data record and firmware are incompatible.		
	No configuration in the data record for the set address offset (ID pins) available.		
21	SPI communication between APPC and MC failed		●
22	Download of the MC firmware failed		●
	CAN bus (Private CAN) is not time-phased.	Check whether the CAN bus (Private CAN) is time-phased. The CAN bus has to be terminated between CAN low and CAN high at the first and last physical node, in each case by a resistor (120 Ω).	
23	Start of the MC firmware failed		●
	CAN bus (Private CAN) is not time-phased.	Check whether the CAN bus (Private CAN) is time-phased. The CAN bus has to be terminated between CAN low and CAN high at the first and last physical node, in each case by a resistor (120 Ω).	
	The MC is addressed on the SDO server 1.	The MC may not be addressed on the SDO server 1 during the flash process (e. g. via “MOBILE Engineer”).	
24	Parameter setting of the MC failed		●
	CAN bus (Private CAN) is not time-phased.	Check whether the CAN bus (Private CAN) is time-phased. The CAN bus has to be terminated between CAN low and CAN high at the first and last physical node, in each case by a resistor (120 Ω).	
	Data record and firmware are incompatible.	Use the data record suitable for the firmware.	
	Invalid PDO Mapping in the data record.	Check PDO mapping in the data record.	

Value	Meaning/cause(s)	Possible remedies	LED1
25	Public CAN Rx Message Timeout		○
26	Private CAN RxPDO Timeout		○
	CAN bus (Private CAN) is not time-phased.	Check whether the CAN bus (Private CAN) is time-phased. The CAN bus has to be terminated between CAN low and CAN high at the first and last physical node, in each case by a resistor (120 Ω).	
27	Setpoint invalid		○
28	spi wuc intercom read failed		○
29	spi wuc intercom config failed		●
30	spi wuc intercom sleep failed		●
31	Short circuit on the CAN bus (Public CAN)	Eliminate short circuit	○
32	General error in the MC		●

○ LED off

● LED on

LED blinking every 0.4 s

LED blinking every 0.2 s

LED blinking pattern: blinking once or several times with a break of 1 s

11 Private CAN - process data

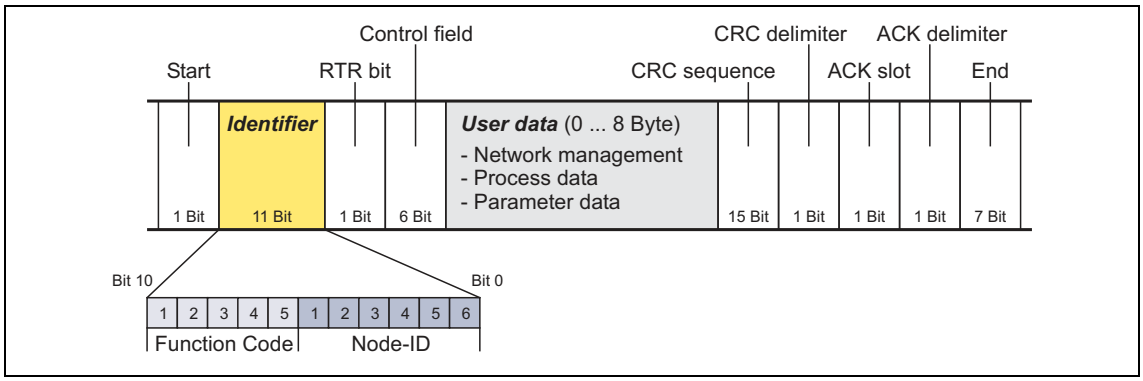
The Application Controller and the Motor Controller are connected via the Private CAN (CAN 2.0A) and communicate in compliance with the Drive Profile DS 402 according to CANopen.

Identifiers of the process data objects

The Private CAN is message-oriented and not node-oriented. Each message has a unique identification, the identifier. The identifier for the process data objects consists of a basic identifier and the CAN address of the Motor Controller:

Identifier (COB-ID) = basic identifier + CAN address$_{\text{Motor Controller}}$ (node ID)

Unlike the CANopen definition, the function code has been extended by one bit and the node ID has been reduced by one bit. This serves to configure maximally 16 PDOs instead of 8 PDOs. In order to prevent overlapping, only node IDs in the range of 1 ... 64 are permitted for the Motor Controller.



[11-1] Basic structure of the CAN telegram

Allocation of the PDOs in the object table

PDO	Basic identifier	Allocation for MOBILE DCU	Allocation for MOBILE DCU/PSU
TPDO 1	0x180	Actual values from device	Actual values from device
TPDO 2	0x1C0	Status from inverter A	Status from onboard converter
TPDO 3	0x240	Actual values (1) from motor A	Actual values (1) from onboard converter
TPDO 4	0x280	Actual values (2) from motor A	Actual values (2) from onboard converter
TPDO 5	0x2C0	Status from inverter B	Status from inverter B
TPDO 6	0x340	Actual values (1) from motor B	Actual values (1) from motor B
TPDO 7	0x380	Actual values (2) from motor B	Actual values (2) from motor B
RPDO 1	0x200	Setpoints (1) for inverter A	Setpoints (1) for onboard converter
RPDO 2	0x300	Setpoints (2) for inverter A	Setpoints (2) for onboard converter
RPDO 3	0x400	Setpoints (1) for inverter B	Setpoints (1) for inverter B
RPDO 4	0x500	Setpoints (2) for inverter B	Setpoints (2) for inverter B
RPDO 5	0x540	Setpoints for device	Time stamp

11.1 Process data objects MOBILE DCU

11.1.1 TPDO 1 - actual values from device

COB-ID	PDO name	Cycle time	Transmitter	Receiver
0x180 + node ID	Device Actual TPDO	20 ms	MC	APPC

Byte	Name	Data type	Index	Mapping
0 - 1	Device actual DC link voltage	INTEGER16	0x2732:0x02	Mandatory
2 - 3	Device actual ambient temperature	INTEGER16	0x2711:0x04	Optional
4 - 5	Device actual DC link power	INTEGER16	0x2732:0x0E	Optional
6 - 7	Dummy Object	UNSIGNED16	0x2001:0x01	Optional

11.1.2 TPDO 2 - status from inverter A

COB-ID	PDO name	Cycle time	Transmitter	Receiver
0x1C0 + node ID	Inverter A status TPDO	20 ms	MC	APPC

Byte	Name	Data type	Index	Mapping
0 - 1	Drive Profile Inverter A statusword	UNSIGNED16	0x6041	Mandatory
2 - 5	Inverter A Supervision: latched status 1	UNSIGNED32	0x2900:0x05	Mandatory
6 - 7	Inverter A Supervision: latched status 2	UNSIGNED16	0x2900:0x07	Mandatory

11.1.3 TPDO 3 - actual values (1) from motor A

COB-ID	PDO name	Cycle time	Transmitter	Receiver
0x240 + node ID	Motor A Actual 1 TPDO	20 ms	MC	APPC

Byte	Name	Data type	Index	Mapping
0 - 3	Drive Profile Inverter A vl velocity actual value	INTEGER32	0x6044	Optional
4 - 5	Drive Profile Inverter A tq torque actual value	INTEGER16	0x6077	Optional
6 - 7	Drive Profile Inverter A tq current actual value	INTEGER16	0x6078	Optional

11.1.4 TPDO 4 - actual values (2) from motor A

COB-ID	PDO name	Cycle time	Transmitter	Receiver
0x280 + node ID	Motor A Actual 2 TPDO	20 ms	MC	APPC

Byte	Name	Data type	Index	Mapping
0 - 1	Motor A: Temperature	INTEGER16	0x2910:0x05	Optional
2 - 3	Motor A: powerActFiltered	INTEGER16	0x292C:0x08	Optional
4 - 5	Motor A: volSActFiltered	INTEGER16	0x292C:0x0B	Optional
6 - 7	Power Module A: Temperature	INTEGER16	0x2810:0x08	Optional

11.1.5 TPDO 5 - status from inverter B

COB-ID	PDO name	Cycle time	Transmitter	Receiver
0x2C0 + node ID	Inverter B Status TPDO	20 ms	MC	APPC

Byte	Name	Data type	Index	Mapping
0 - 1	Drive Profile Inverter B statusword	UNSIGNED16	0x6841	Mandatory
2 - 5	Inverter B Supervision: latched status 1	UNSIGNED32	0x3100:0x05	Mandatory
6 - 7	Inverter B Supervision: latched status 2	UNSIGNED16	0x3100:0x07	Mandatory

11.1.6 TPDO 6 - actual values (1) from motor B

COB-ID	PDO name	Cycle time	Transmitter	Receiver
0x340 + node ID	Motor B Actual 1 TPDO	20 ms	MC	APPC

Byte	Name	Data type	Index	Mapping
0 - 3	Drive Profile Inverter B vl velocity actual value	INTEGER32	0x6844	Optional
4 - 5	Drive Profile Inverter B tq torque actual value	INTEGER16	0x6877	Optional
6 - 7	Drive Profile Inverter B tq current actual value	INTEGER16	0x6878	Optional

11.1.7 TPDO 7 - actual values (2) from motor B

COB-ID	PDO name	Cycle time	Transmitter	Receiver
0x380 + node ID	Motor B Actual 2 TPDO	20 ms	MC	APPC

Byte	Name	Data type	Index	Mapping
0 - 1	Motor B: Temperature	INTEGER16	0x3110:0x05	Optional
2 - 3	Motor B: powerActFiltered	INTEGER16	0x312C:0x0B	Optional
4 - 5	Motor B: volSActFiltered	INTEGER16	0x292C:0x0B	Optional
6 - 7	Power Module B: Temperature	INTEGER16	0x3010:0x08	Optional

11.1.8 RPDO 1 - setpoints (1) for inverter A

COB-ID	PDO name	Cycle time	Transmitter	Receiver
0x200 + node ID	Inverter A Setpoint 1 RPDO	20 ms	APPC	MC

Byte	Name	Data type	Index	Mapping
0 - 1	Drive Profile Inverter A controlword	UNSIGNED16	0x6040	Mandatory
2 - 5	Drive Profile Inverter A vl target velocity	INTEGER32	0x6042	Optional
6 - 7	Drive Profile Inverter A tq target torque	INTEGER16	0x6071	Optional

11.1.9 RPDO 2 - setpoints (2) for inverter A

COB-ID	PDO name	Cycle time	Transmitter	Receiver
0x300 + node ID	Inverter A Setpoint 2 RPDO	20 ms	APPC	MC

Byte	Name	Data type	Index	Mapping
0 - 1	Motor A Dc Link Controller: volDcLinkMaxSetp	INTEGER16	0x2926:0x01	Optional
2 - 3	Motor A Dc Link Controller: volDcLinkMinSetp	INTEGER16	0x2926:0x02	Optional
4 - 5	Motor A motoring power limit	INTEGER16	0x60E0:0x00	Optional
6 - 7	Motor A generating power limit	INTEGER16	0x60E1:0x00	Optional

11.1.10 RPDO 3 - setpoints (1) for inverter B

COB-ID	PDO name	Cycle time	Transmitter	Receiver
0x400 + node ID	Inverter B Setpoint 1 RPDO	20 ms	APPC	MC

Byte	Name	Data type	Index	Mapping
0 - 1	Drive Profile Inverter B controlword	UNSIGNED16	0x6840	Mandatory
2 - 5	Drive Profile Inverter B vl target velocity	INTEGER32	0x6842	Optional
6 - 7	Drive Profile Inverter B tq target torque	INTEGER16	0x6871	Optional

11.1.11 RPDO 4 - setpoints (2) for inverter B

COB-ID	PDO name	Cycle time	Transmitter	Receiver
0x500 + node ID	Inverter B Setpoint 2 RPDO	20 ms	APPC	MC

Byte	Name	Data type	Index	Mapping
0 - 1	Motor B Dc Link Controller: volDcLinkMaxSetp	INTEGER16	0x3126:0x01	Optional
2 - 3	Motor B Dc Link Controller: volDcLinkMinSetp	INTEGER16	0x3126:0x02	Optional
4 - 5	Motor B motoring power limit	INTEGER16	0x68E0:0x00	Optional
6 - 7	Motor B generating power limit	INTEGER16	0x68E1:0x00	Optional

11.1.12 RPDO 5 - setpoints for device

COB-ID	PDO name	Cycle time	Transmitter	Receiver
0x540 + node ID	Device setpoint RPDO	20 ms	APPC	MC

RPDO 5 - Setpoints up to firmware R6.3

Byte	Name	Data type	Index	Mapping
0 - 1	Event Buffer: systemTimeStamp	UNSIGNED16	0x270A:0x04	Mandatory
2 - 3	Dummy Object	UNSIGNED16	0x2001:0x01	Optional
4 - 5	Dummy Object	UNSIGNED16	0x2001:0x01	Optional
6 - 7	Dummy Object	UNSIGNED16	0x2001:0x01	Optional

RPDO 5 - Setpoints as of firmware R6.4

Byte	Name	Data type	Index	Mapping
0 - 3	systemTimeStamp	UNSIGNED32	0x270A:0x04	Mandatory
4 - 5	DC Link voltage precharge demand	INTEGER16	0x2732:0x0A	Optional
6 - 7	Dummy Object	UNSIGNED16	0x2000:0x01	Optional

11.2 Process data objects MOBILE DCU PSU

11.2.1 TPDO 1 - actual values from device

COB-ID	PDO name	Cycle time	Transmitter	Receiver
0x180 + node ID	Device Actual TPDO	20 ms	MC	APPC

Byte	Name	Data type	Index	Mapping
0 - 1	Device actual DC link voltage	INTEGER16	0x2732:0x02	Mandatory
2 - 3	Device actual ambient temperature	INTEGER16	0x2711:0x04	Optional
4 - 5	Device actual DC link power	INTEGER16	0x2732:0x0E	Optional
6 - 7	Dummy Object	UNSIGNED16	0x2001:0x01	Optional

11.2.2 TPDO 2 - status from onboard converter

COB-ID	PDO name	Cycle time	Transmitter	Receiver
0x1C0 + node ID	DC Converter A Status TPDO	20 ms	MC	APPC

Byte	Name	Data type	Index	Mapping
0 - 1	Drive Profile DC Converter statusword	UNSIGNED16	0x6041	Mandatory
2 - 5	DC Converter Supervision: latched status 1	UNSIGNED32	0x2900:0x05	Mandatory
6 - 7	DC Converter Supervision: latched status 2	UNSIGNED16	0x2900:0x07	Mandatory

11.2.3 TPDO 3 - actual values (1) from onboard converter

COB-ID	PDO name	Cycle time	Transmitter	Receiver
0x240 + node ID	DC Converter A Actual 1 TPDO	20 ms	MC	APPC

Byte	Name	Data type	Index	Mapping
0 - 1	Drive Profile DC Converter actual secondary voltage	INTEGER16	0x6202	Mandatory
2 - 3	Drive Profile DC Converter actual secondary current	INTEGER16	0x6203	Mandatory
4 - 5	Dummy Object	UNSIGNED16	0x2001:0x01	Optional
6 - 7	Dummy Object	UNSIGNED16	0x2001:0x01	Optional

11.2.4 TPDO 4 - actual values (2) from onboard converter

COB-ID	PDO name	Cycle time	Transmitter	Receiver
0x280 + node ID	DC Converter A Actual 2 TPDO	20 ms	MC	APPC

Byte	Name	Data type	Index	Mapping
0 - 1	DC Driver: temperature1	INTEGER16	0x2810:0x08	Mandatory
2 - 3	DC Driver: temperature2	INTEGER16	0x2810:0x09	Mandatory
4 - 5	DC Controller Power Calculation: powerFiltered	INTEGER16	0x291D:0x02	Mandatory
6 - 7	Dummy Object	UNSIGNED16	0x2001:0x01	Optional

11.2.5 TPDO 5 - status from inverter B

COB-ID	PDO name	Cycle time	Transmitter	Receiver
0x2C0 + node ID	Inverter B Status TPDO	20 ms	MC	APPC

Byte	Name	Data type	Index	Mapping
0 - 1	Drive Profile Inverter B statusword	UNSIGNED16	0x6841	Mandatory
2 - 5	Inverter B Supervision: latched status 1	UNSIGNED32	0x3100:0x05	Mandatory
6 - 7	Inverter B Supervision: latched status 2	UNSIGNED16	0x3100:0x07	Mandatory

11.2.6 TPDO 6 - actual values (1) from motor B

COB-ID	PDO name	Cycle time	Transmitter	Receiver
0x340 + node ID	Motor B Actual 1 TPDO	20 ms	MC	APPC

Byte	Name	Data type	Index	Mapping
0 - 3	Drive Profile Inverter B vl velocity actual value	INTEGER32	0x6844	Optional
4 - 5	Drive Profile Inverter B tq torque actual value	INTEGER16	0x6877	Optional
6 - 7	Drive Profile Inverter B tq current actual value	INTEGER16	0x6878	Optional

11.2.7 TPDO 7 - actual values (2) from motor B

COB-ID	PDO name	Cycle time	Transmitter	Receiver
0x380 + node ID	Motor B Actual 2 TPDO	20 ms	MC	APPC

Byte	Name	Data type	Index	Mapping
0 - 1	Motor B: Temperature	INTEGER16	0x3110:0x05	Optional
2 - 3	Motor B: powerActFiltered	INTEGER16	0x311D:0x1E	Optional
4 - 5	Motor B: volSActFiltered	INTEGER16	0x311D:0x23	Optional
6 - 7	Power Module B: Temperature	INTEGER16	0x3010:0x08	Optional

11.2.8 RPDO 1 - setpoints (1) for onboard converter

COB-ID	PDO name	Cycle time	Transmitter	Receiver
0x200 + node ID	DC Converter A Setpoint 1 RPDO	20 ms	APPC	MC

Byte	Name	Data type	Index	Mapping
0 - 1	DC Converter A controlword	UNSIGNED16	0x6040	Mandatory
2 - 3	Drive Profile DC Converter target secondary voltage	INTEGER16	0x6200	Optional
4 - 5	Drive Profile DC Converter target secondary current	INTEGER16	0x6201	Optional
6 - 7	DC Controller DC Link Min Controller: volDcLinkMinSetp	INTEGER16	0x291E:0x02	Optional

11.2.9 RPDO 2 - setpoints (2) for onboard converter

COB-ID	PDO name	Cycle time	Transmitter	Receiver
0x300 + node ID	DC Converter A Setpoint 2 RPDO	20 ms	APPC	MC

Byte	Name	Data type	Index	Mapping
0 - 1	Dummy Object	UNSIGNED16	0x2001:0x01	Optional
2 - 3	Dummy Object	UNSIGNED16	0x2001:0x01	Optional
4 - 5	Dummy Object	UNSIGNED16	0x2001:0x01	Optional
6 - 7	Dummy Object	UNSIGNED16	0x2001:0x01	Optional

11.2.10 RPDO 3 - setpoints (1) for inverter B

COB-ID	PDO name	Cycle time	Transmitter	Receiver
0x400 + node ID	Inverter B Setpoint 1 RPDO	20 ms	APPC	MC

Byte	Name	Data type	Index	Mapping
0 - 1	Drive Profile Inverter B controlword	UNSIGNED16	0x6840	Mandatory
2 - 5	Drive Profile Inverter B vl target velocity	INTEGER32	0x6842	Optional
6 - 7	Drive Profile Inverter B tq target torque	INTEGER16	0x6871	Optional

11.2.11 RPDO 4 - setpoints (2) for inverter B

COB-ID	PDO name	Cycle time	Transmitter	Receiver
0x500 + node ID	Inverter B Setpoint 2 RPDO	20 ms	APPC	MC

Byte	Name	Data type	Index	Mapping
0 - 1	Motor B Dc Link Controller: volDcLinkMaxSetp	INTEGER16	0x3126:0x01	Optional
2 - 3	Motor B Dc Link Controller: volDcLinkMinSetp	INTEGER16	0x3126:0x02	Optional
4 - 5	Motor B motoring power limit	INTEGER16	0x68E0:0x00	Optional
6 - 7	Motor B generating power limit	INTEGER16	0x68E1:0x00	Optional

11.2.12 RPDO 5 - setpoints for device

COB-ID	PDO name	Cycle time	Transmitter	Receiver
0x540 + node ID	Device setpoint RPDO	20 ms	APPC	MC

RPDO 5 - Setpoints up to firmware R6.3

Byte	Name	Data type	Index	Mapping
0 - 1	Event Buffer: systemTimeStamp	UNSIGNED16	0x270A:0x04	Mandatory
2 - 3	Dummy Object	UNSIGNED16	0x2001:0x01	Optional
4 - 5	Dummy Object	UNSIGNED16	0x2001:0x01	Optional
6 - 7	Dummy Object	UNSIGNED16	0x2001:0x01	Optional

RPDO 5 - Setpoints as of firmware R6.4

Byte	Name	Data type	Index	Mapping
0 - 3	systemTimeStamp	UNSIGNED32	0x270A:0x04	Mandatory
4 - 5	DC Link voltage precharge demand	INTEGER16	0x2732:0x0A	Optional
6 - 7	Dummy Object	UNSIGNED16	0x2000:0x01	Optional

11.3 Timeout monitoring of the RPDOs

The MOBILE monitors the continuous reception of the RPDOs.

- For each RPDO a separate monitoring is executed.
- Monitoring only takes place if the transmission type for the RPDO is higher than 253 and the event timer is set to non-zero ms. This is the case in the default setting.
- Monitoring gets active as soon as the corresponding RPDO has been received for the first time by the Motor Controller.
- If an RPDO remains off for a longer time than set in the event timer, the "No PDO received (time-out)" status is signalled via the MC status word 1 (bit 19 for DCU; bit 21 for PSU) and the error response set is triggered (default setting: "4: Coasting to standstill/error setting").
- The event timer is preset to 100 ms for all RPDOs.

PDO	Monitoring settings			Flag "missed RPDO"
	Transmission type	Event timer	Error response	
RPDO 1	0x1400:0x02	0x1400:0x05	0x2900:0x09	0x2901:0x0E - Bit 0
RPDO 2	0x1401:0x02	0x1401:0x05		0x2901:0x0E - Bit 1
RPDO 3	0x1402:0x02	0x1402:0x05	0x3100:0x09	0x3101:0x0E - Bit 0
RPDO 4	0x1403:0x02	0x1403:0x05		0x3101:0x0E - Bit 1
RPDO 5	0x1404:0x02	0x1404:0x05	0x2900:0x09 0x3100:0x09	0x2901:0x0E - Bit 3 **AND** 0x3101:0x0E - Bit 3

11.4 Error response to CAN communication failure

The 0x2900:0x09 object (or 0x3100:0x09) serves to parameterise which error response is to take place in case of a CAN communication error.

The following CAN communication errors are monitored:

- Timeout of the RPDOs. ▸ Timeout monitoring of the RPDOs
- NMT state machine is not in "Operational" state

11.5 PDO dummy mapping

Note!

The mapping of the parameters marked as optional can be changed. However, the correct triggering of the Motor Controller via the Application Controller cannot be controlled anymore!

If you have any questions, please contact the Bucher support.

By means of the dummy objects given below, gaps can be implemented in the PDOs. 2-byte or 4-byte gaps can be implemented. For this purpose, gaps in RPDOs have to be mapped to write-only objects and gaps in TPDOs have to be mapped to read-only objects with the corresponding length.

A maximum of 16-bit values can be mapped to each PDO. If the maximum data length of 8 bytes has been already used with 2 or 3 mapped objects, or should a PDO be reduced, the prevailing mapping parameter "Number of Entries" has to be reduced to the number of mapped objects.

Dummy object	Name	Length	Read-only	Write-only
0x2000:0x01	Write-Only Dummy Objects: UNSIGNED16	2 bytes		●
0x2000:0x02	Write-Only Dummy Objects: UNSIGNED32	4 bytes		●
0x2001:0x01	Read-Only Dummy Objects: UNSIGNED16	2 bytes	●	
0x2002:0x02	Read-Only Dummy Objects: UNSIGNED32	4 bytes	●	

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