

Function requirements, general

- Engine off or drivetrain not ready (Vehicle parked)

i The ME-SFI [ME] control unit (N3/10) sends the "Engine off" or "Drivetrain not ready" signal over the chassis CAN 1 (CAN E1), front SAM control unit with fuse and relay module (N10/1) and interior CAN (CAN B) to the rear SAM control unit with fuse and relay module (N10/2).

Engine OFF energy management encompasses the following subfunctions:

- **Function sequence for consumer shutoff**
- **Function sequence for no-load current management**
- **Function sequence for remote charging/jump start**

Additional function requirements for consumer shutoff

D Circuit 15 ON or circuit 15R ON

D On-board electrical system emergency mode not active

i The electronic ignition lock control unit (N73) transmits the circuit status of circuit 15 via the interior CAN to the rear SAM control unit.

Engine off energy management, general

Engine off energy management ensures the stability of the on-board electrical system and the starting capability of the engine when the vehicle is at a standstill.

This functionality is integrated into the rear SAM control unit and serves to extend the service life of the on-board electrical system battery (G1). To this end, active electrical consumers may be switched off.

Function sequence for consumer shutoff

The rear SAM control unit actuates the consumer shutoff function under the following conditions:

- On-board electrical system voltage lowered to less than U = 11.8 V
- Engine Off
- Change from circuit 15 ON to circuit 15R ON

Given constant shutoff conditions, one consumer will be shut off every t = 5 s in addition to the consumer reduction from the engine on energy management function.

The shutoff sequence is shown in the table below.

i The list includes those consumers whose power supply is reduced or cutoff as part of the engine on energy management function (up to shutoff step 9).

Shutoff step	Shutoff stage	Consumers with reduced or no power	Executing control unit	Maximum Current in A
1	7	Seat heater level 3 (with code (873) Seat heater for left and right front seats)	Rear SAM control unit with fuse and relay module (N10/2)	13.2
2	8	Seat heater level 2 (with code (873) Seat heater for left and right front seats)	Rear SAM control unit with fuse and relay module (N10/2)	13.2
3	9	Wiper park position heater (R2/10) via wiper park position heater relay (N10/1kL)	Front SAM control unit with fuse and relay module (N10/1)	15
4	10	Mirror heater (M21/1r1) and mirror heater (M21/2r1)	Left door control unit (N69/1) and Right door control unit (N69/2)	3.5
5	12	Rear window heater (R1)	Rear SAM control unit with fuse and relay module (/N10/2)	30
6	14	Blower motor (A32m1) P = 50%	Automatic air conditioning control and operating unit (N22/7)	16
7	15	Fan motor (M4/7) P = 50%	Automatic air conditioning control and operating unit (N22/7)	31
8	16	Circuit 15R relay (1) (N10/2kB)	Rear SAM control unit with fuse and relay module (N10/2)	6
9	18	Seat heater stage 1 (with code (873) Seat heater for left and right front seats)	Rear SAM control unit with fuse and relay module (N10/2)	3.3
10	19	Residual engine heat utilization (without code (494) USA version)	Automatic air conditioning control and operating unit (N22/7)	8
11	21	COMAND controller unit (A40/3)	COMAND controller unit (A40/3)	2

Even when the on-board electrical system voltage is stabilized at a value higher than

U = 11.8 V, consumer shutoff is not revoked. The switched off consumers are not activated again until a reset is made by turning the transmitter key (A8/1) to the circuit 15C ON position.

Additional function requirements for no-load current management

- Transition from circuit 15R to circuit 15C

i The electronic ignition lock control unit sends the circuit 15 status over the interior CAN to the rear SAM control unit.

Function sequence for no-load current management

No-load current management ensures the engine's starting capability even after extended idle times. No-load current management is integrated into the rear SAM control unit.

Actuation of the no-load current management relay (F32k2) shuts off consumers that are supplied with power through circuit 30g.

No-load current management however, can accommodate increased power consumption for a specific period after switching off the engine (maximum t = 75 min.). This allows, for example, the radio to be played while the car is being washed.

No-load current management cyclically measures the voltage and power consumption every t = 6 minutes. If an excessively high no-load current is determined for a specific period, the no-load current management relay is opened at the earliest after t = 75 min., but no later than 6 h.

Following a period of $t = 6$ h, or as soon as the on-board electrical system's voltage values drop below certain limits and compromise the engine's starting capability, the extended run-on monitoring function initiates the following actions:

- Activation of no-load current management over CAN
- Open no-load current shutoff relay

Before opening the no-load current switch relay a corresponding signal is sent over the CAN to shutdown the control units.

No-load current management encompasses the following subfunctions:

- **Function sequence for no-load current shutoff**
- **Function sequence for no-load current diagnosis**
- **No-load current reference value/residual charging current assessment function sequence**

If during the waiting time the on-board electrical system voltage falls to $U < 11.8$ V drops, the no-load current shutoff relay will be opened early.

i If $U < 11.8$ V, the battery sensor will go into sleep mode (reduced power consumption).

$T = 5$ min. before opening the no-load current shutoff relay the rear SAM control unit sends a cutoff signal as advance notice to all the control units supplied with power through circuit 30g. The front SAM control unit sends this shutdown signal over the interior CAN and chassis CAN 1.

The following control units receive the shutoff signal via the interior CAN:

- Instrument cluster (A1)
- COMAND controller unit (A40/3)

The following control units receive the shutoff signal over the chassis CAN 1:

- Left front reversible emergency tensioning retractor (A76)
- Right front reversible emergency tensioning retractor (A76/1)
- Supplemental restraint system control unit (N2/10)
- ME-SFI [ME] control unit
- Steering column tube module control unit (N80)
- Transmission mode control unit (N145) (in model 231.474/479)

Function sequence for energize consumers

The no-load current management closes the no-load current shutoff relay as soon as a system is activated. All the functions are then available again.

The no-load current shutoff relay is opened again when the waiting time of $t = 6$ h has expired, the on-board electrical system voltage is less than $U = 11.8$ V or the no-load current is too high.

If the rear SAM control unit receives a wake-up signal, no-load current management closes the no-load current shutoff relay and signals, via the interior CAN, that the wake-up conditions for the control units are again active. The front SAM control unit receives this signal and sends it over the chassis CAN 1 to the control units connected to the chassis CAN 1.

Function sequence for no-load current shutoff

No-load current management encompasses the following subfunctions:

- Function sequence for requesting consumer shutoff (no-load current switch)
- Function sequence for shut off consumers
- Function sequence for energize consumers

Function sequence for requesting consumer shutoff (no-load current switch)

During the transition from circuit 15R to circuit 15C, the vehicle changes to the "vehicle rest" operating state. The timer counting down to no-load current shutoff is then started (waiting time $t = 6$ h). The no-load current is continuously monitored by the battery sensor (B95). If the no-load current is too high, the no-load current shutoff relay will be opened at the earliest after $t = 75$ minutes. The rear SAM control unit reads in the data from the battery sensor over the on-board electrical system LIN (LIN B7) and evaluates it.

- Active multicontour seat pneumatic pump (M40/1) (With code (432) Active multicontour seat)
- Front SAM control unit
- Automatic air conditioning control and operating unit (N22/7)
- AIRSCARF control unit (N25/7) (with code (403) AIRSCARF system)
- Driver seat control unit (N32/1)
- Front passenger seat control unit (N32/2)
- Driver-side active multicontour seat control unit (N32/19) (With code (432) Active multicontour seat)
- Passenger-side active multicontour seat control unit (N32/22) (With code (432) Active multicontour seat)
- Vario roof control control unit (N52)
- Left door door control unit (N69/1)
- Right door control unit (N69/2)
- Keyless-Go control unit (N69/5) (with code (889) Keyless-Go)
- Electronic ignition switch control unit

If the interior CAN and chassis CAN 1 are in "sleep mode" during signal transmission, the corresponding control units will be woken up. The control units will then prepare themselves for power supply shutoff.

Within $t = 5$ min., these control units will go into "power-down mode" (decentralized power management).

Function sequence for shut off consumers

Following a period of $t = 5$ min., no-load current management opens the no-load current shutoff relay provided no closing causing event has occurred in the meantime. The rear SAM control unit sends the switching status of the no-load current shutoff relay over the interior CAN. The front SAM control unit receives this and sends it over the chassis CAN 1 to the control units that are connected to chassis CAN 1.

The following conditions will trigger the closure of the no-load current shutoff relay:

- Circuit 15R switches on:
 - The waiting time timer is reset. The no-load current shutoff relay remains closed as long as the status of circuit 15R is ON.
- A door is unlocked or opened or circuit 15C is switched on:
 - The waiting time timer is reset.
- The hazard warning system, the standing or parking lights, or the signaling system on special-purpose vehicles is switched on:
 - The waiting time timer is reset.
- Activation of antitheft alarm system (ATA):

Closing the no-load current shutoff relay causes power to again be supplied via circuit 30g.

Function sequence for no-load current diagnosis

No-load current diagnosis records data to help troubleshoot possible fault profiles.

The no-load current diagnosis function encompasses the following subfunctions:

D Function sequence for activate no-load current diagnosis

D Function sequence for cancel/end no-load current diagnosis

Additional function requirements for Activate no-load current diagnosis

- Circuit 15R OFF

The following data are stored in nonvolatile memory in the no-load current fault roll:

- No-load current value upon occurrence of wake-up event
- Maximum no-load current during no-load current fault phase
- Minimum no-load current during no-load current fault phase
- Voltage of on-board electrical system battery upon occurrence of wake-up event
- Voltage of on-board electrical system battery at end of no-load current fault phase
- Duration of no-load current fault phase (in minutes)
- Kilometer reading
- Consumer status

As long as no-load current diagnosis is active, each additional battery sensor wake-up event will cause the data record to be updated.

Additional function requirements for no-load current reference value/residual charging current assessment

- Circuit 30 ON

No-load current reference value/residual charging current assessment function sequence

After the vehicle has gone through production testing and possible runs on the test track, the no-load current has to be measured and an assessment made of the residual charge current of the on-board electrical system battery.

The no-load current-reference value/residual charging current encompasses the following subfunctions:

- Function sequence for no-load current reference value measurement
- Function sequence for residual charge current assessment

No-load current reference value measurement function sequence

The measurement of the no-load current reference value is started using the diagnostic-tester at circuit 15R or higher.

The message "Measure no-load current" appears in the multifunction display (A1p13) of the instrument cluster.

Function sequence for residual charge current assessment

During production, charge is removed from the battery in the course of various function tests. The charge level of the on-board electrical system battery must therefore be assessed at the end of assembly. The charge level (ratio of current charge to the maximum storable charge in the on-board electrical system battery) serves as the measure for a sufficiently charged on-board electrical system battery.

The waiting time timer is reset.

- The panic alarm is triggered (with code (763) Radio remote control with panic switch): The waiting time timer will be reset.

Function sequence for activate no-load current diagnosis

The battery sensor starts the no-load current diagnosis over the on-board electrical system LIN if one of the following events occurs:

- Increased no-load current following expiration of tolerance time of $t = 75$ min.
- On-board electrical system voltage values fall below limits and there has been a change in the kilometer reading since the last fault roll entry caused by undervoltage (also before expiration of tolerance time of $t = 75$ min.)

With the first waking event an entry in the no-load current fault roll takes place. Following this, the no-load current is cyclically checked. These values will be updated if there are significant changes or if the no-load current diagnosis is canceled.

Additional function requirements for cancel/end no-load current diagnosis

D Circuit 15R ON

D On-board electrical system voltage values fall below limits

Function sequence for cancel/end no-load current diagnosis

No-load current diagnosis will be canceled if the on-board electrical system voltage values fall below the defined limits ($U = 11.8$ V) The battery sensor will discontinue no-load current monitoring in order to minimize electricity consumption. Once this happens, no further entries will be added to the quiescent current fault roll.

The diagnostic tester must then be removed and the vehicle locked so that the vehicle's no-load current will quickly drop. The battery sensor will then sense and save the maximum no-load current level to occur following the locking of the vehicle. After the vehicle is woken up, the battery sensor sends the measured no-load current value via the on-board electrical system LIN to the rear SAM control unit, which then saves it as the no-load current reference value in nonvolatile memory. The no-load current reference value can be read out using the diagnostic tester.

i If the measured no-load current is within a defined tolerance range, the message in the multifunction display will disappear.

i If the no-load current reference value is too high, a fault message will be shown in the multifunction display of the instrument cluster and measurement will begin again.

Function sequence for remote charging/jump start

If the on-board electrical system battery does not have enough capacity to start the engine, the on-board electrical system battery must be charged or a jump start carried out.

i One of the front doors must be opened during a jump start procedure or during any testing in the workshop to enable the


This value must be above 80%.

If the charge level is below 80%, a fault message will be shown in the multifunction display of the instrument cluster.

Measurement of the residual charge current is only done following successful measurement of the no-load current reference value.

As a rule, the two values are released together.

alternator management to change to the external starting aid mode or the workshop mode and the alternator voltage to be increased to $U = 14.3 \text{ V}$.

	Electrical function schematic for consumer shutoff		PE54.10-P-2066-97RKA
	Overview of system components for energy management		GF54.10-P-9990RK