

Document title Engine off energy management, function

Document number gf5410p1050fl

MODEL 212.0 /2 up to 28.2.13**Function requirements, general**

- "Engine running" or "drivetrain operational" signal not set (vehicle switched off)

i The CDI control unit (N3/9) (with diesel engine) or the ME-SFI [ME] control unit (N3/10) (with gasoline engine) sends the "Engine running" or the "Drivetrain operational" signal over the chassis CAN (CAN E), 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 parked.

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 as of 1.6.12 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 17).

Shutoff step	Switch off stage	Consumers with reduced or no power	Executing control unit	Maximum Current in A
1	1	Heating level 6, PTC [positive temperature coefficient] heater booster (R22/3) (with engine 271.8, 642.8, 651.9), passenger side	Automatic air conditioning control and operating unit (N22/7)	18.5
2	2	Heating level 5, PTC heater booster (R22/3) (with engine 271.8, 642.8, 651.9) driver side	Automatic air conditioning control and operating unit (N22/7)	18.5
3	3	Heating level 4, PTC [positive temperature coefficient] heater booster (R22/3) (with engine 271.8, 642.8, 651.9) front passenger side	Automatic air conditioning control and operating unit (N22/7)	18.5
4	4	Heating level 3, PTC heater booster (R22/3) (with engine 271.8, 642.8, 651.9) driver side	Automatic air conditioning control and operating unit (N22/7)	18.5
5	5	Heating level 2, PTC [positive temperature coefficient] heater booster (R22/3) (with engine 271.8, 642.8, 651.9) front passenger side	Automatic air conditioning control and operating unit (N22/7)	18.5
6	6	Heating level 1, PTC heater booster (R22/3) (with engine 271.8, 642.8, 651.9), driver side	Automatic air conditioning control and operating unit (N22/7)	18.5
7	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
8	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
9	9	Wiper park position heater (R2/10)	Front SAM control unit with fuse and relay module (N10/1)	15.0
10	10	Mirror heater (M21/1r1) and mirror heater (M21/2r1)	Left front door control unit (N69/1) and Right front door control unit (N69/2)	3.5
11	11	Steering wheel heater electronics (A74) (with code (443) steering wheel heater)	Steering wheel heater control unit (N25/7)	8.0
12	12	Rear window heater (R1)	Rear SAM control unit with fuse and relay module (N10/2)	30.0
13	13	Rear blower motor (M2/1) (with code (581) C-AAC) P = 50 %	Automatic air conditioning control and operating unit (N22/7)	5.5
14	14	Blower motor (A32m1) P = 50%	Automatic air conditioning control and operating unit (N22/7)	16.0
15	15	Combustion engine fan motor and air conditioning with integrated control (M4/7) P = 50%	Automatic air conditioning control and operating unit (N22/7)	31.0
16	16	Circuit 15R relay (1) (N10/2kB)	Rear SAM control unit with fuse and relay module (N10/2)	6
17	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
18	19	Residual heat utilization (with code (581) Comfort automatic air conditioning and without code (494) USA version)	Automatic air conditioning control and operating unit (N22/7)	8

		Rear automatic air conditioning operating unit (N22/4) (with code (581) Comfort automatic air conditioning)		6
19	20	Stationary heater (with code (228) Stationary heater)	Stationary heater control unit (A6n1)	10
20	21	Radio (A2) (with code (523) MB Audio 20 radio or code (510) Audio 20 incl. CD changer) or Radio with auto pilot system (A2/56) (with code (525) MB Audio 50 APS radio or code (511) Audio 50 APS incl. DVD changer) or COMAND controller unit (A40/3) (with code (512) COMAND APS incl. DVD changer or code (526) COMAND with single DVD drive (without navigation) or code (527) COMAND APS with single DVD drive (with navigation) or code (528) COMAND incl. DVD changer)	Radio (A2) or Radio with auto pilot system (A2/56) or COMAND controller unit (A40/3)	2

The shutoff sequence is shown up to 31.5.12 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 19).

Shutoff step	Switch off stage	Consumers with reduced or no power	Executing control unit	Maximum Current in A
1	1	Heating level 6, PTC [positive temperature coefficient] heater booster (R22/3) (with engine 271.8, 642.8, 651.9), passenger side	Automatic air conditioning control and operating unit (N22/7)	18.5
2	2	Heating level 5, PTC heater booster (R22/3) (with engine 271.8, 642.8, 651.9) driver side	Automatic air conditioning control and operating unit (N22/7)	18.5
3	3	Heating level 4, PTC [positive temperature coefficient] heater booster (R22/3) (with engine 271.8, 642.8, 651.9) front passenger side	Automatic air conditioning control and operating unit (N22/7)	18.5
4	4	Heating level 3, PTC heater booster (R22/3) (with engine 271.8, 642.8, 651.9) driver side	Automatic air conditioning control and operating unit (N22/7)	18.5
5	5	Heating level 2, PTC [positive temperature coefficient] heater booster (R22/3) (with engine 271.8, 642.8, 651.9) front passenger side	Automatic air conditioning control and operating unit (N22/7)	18.5
6	6	Heating level 1, PTC heater booster (R22/3) (with engine 271.8, 642.8, 651.9), driver side	Automatic air conditioning control and operating unit (N22/7)	18.5
7	7	Rear blower motor (M2/1) (with code (581) C-AAC) P = 50 %	Automatic air conditioning control and operating unit (N22/7)	5.5
8	8	Blower motor (A32m1) P = 50%	Automatic air conditioning control and operating unit (N22/7)	16.0
9	9	Combustion engine fan motor and air conditioning with integrated control (M4/7) P = 50%	Automatic air conditioning control and operating unit (N22/7)	31.0
10	10	Trailer socket (X58) (with code (550) Trailer hitch)	Trailer recognition control unit (N28/1) (with code (550) Trailer hitch)	8
11	11	Circuit 15R relay (1) (N10/2kB)	Rear SAM control unit with fuse and relay module (N10/2)	6
12	12	Seat ventilation (with code (401) Front comfort seats, incl. seat heating and seat ventilation)	Rear SAM control unit with fuse and relay module (N10/2)	2.2
13	13	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
14	14	Rear window heater (R1)	Rear SAM control unit with fuse and relay module (N10/2)	30.0
15	15	Wiper park position heater (R2/10)	Front SAM control unit with fuse and relay module (N10/1)	15.0
16	16	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
17	17	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
18	18	Steering wheel heater electronics (A74) (with code (443) steering wheel heater)	Steering wheel heater control unit (N25/7)	8,0
19	20	Mirror heater (M21/1r1) and mirror heater (M21/2r1)	Left front door control unit (N69/1) and Right front door control unit (N69/2)	3.5
20	21	Residual heat utilization (with code (581) Comfort automatic air conditioning and without code (494) USA version) Rear automatic air conditioning operating unit (N22/4) (with code (581) Comfort automatic air conditioning)	Automatic air conditioning control and operating unit (N22/7)	8 6
21	22	Rear dome lamp (E15/3) Right luggage compartment lamp (E18/4) Left luggage compartment lamp (E18/5)	Front SAM control unit with fuse and relay module (N10/1) (without code (414) Power glass tilting/sliding sunroof) or Overhead control panel control unit (N70) (with code (414) Power glass tilting/sliding sunroof) Rear SAM control unit with fuse and relay module (N10/2)	1 0.5

22	23	Roof sign lamp (E14/4), printer and card reader (with code (965) Electrical preinstallation for rental vehicles)	Special-purpose vehicle multifunction control unit (N26/9) (with code (965) Electrical preinstallation for rental vehicle)	5
23	24	Stationary heater (with code (228) Stationary heater)	Stationary heater control unit (A6n1)	10
24	25	Radio (A2) (with code (523) MB Audio 20 radio or code (510) Audio 20 incl. CD changer) or Radio with auto pilot system (A2/56) (with code (525) MB Audio 50 APS radio or code (511) Audio 50 APS incl. DVD changer) or COMAND controller unit (A40/3) (with code (512) COMAND APS incl. DVD changer or code (526) COMAND with single DVD drive (without navigation) or code (527) COMAND APS with single DVD drive (with navigation) or code (528) COMAND incl. DVD changer)	Radio (A2) or Radio with auto pilot system (A2/56) or COMAND controller unit (A40/3)	2

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

$U = 11.8 \text{ V}$, 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.

Following a period of $t = 6 \text{ h}$, 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:

- Activate no-load current shutoff via Controller Area Network (data bus/CAN Bus) (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. This in turn, authorizes e.g. the overhead control panel control unit to move an open tilting/sliding roof to the tilt position.

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 $U < 11.8 \text{ V}$ drops, the no-load current shutoff relay will be opened early.

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

$T = 5 \text{ min.}$ 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 cutoff signal over the chassis CAN to the control units connected to the chassis CAN.

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

- Instrument cluster (A1)
- Radio (A2) (with code (523) MB Audio 20 radio or code (510) Audio 20 with CD changer)

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 $t = 75 \text{ min.}$). 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 $t = 6 \text{ minutes}$. 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 $t = 75 \text{ min.}$, but no later than $t = 6 \text{ h}$.

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 $t = 6 \text{ h}$). 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 $t = 75 \text{ minutes}$. 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.

- Radio with auto pilot system (A2/56)
(with code (525) MB Audio 50 APS radio or code (511) Audio 50 APS with DVD changer)
- COMAND controller unit (A40/3)
(with code (512) COMAND APS incl. DVD changer or code (526) COMAND with single DVD drive (without navigation) or code (527) COMAND APS with single DVD drive (with navigation) or code (528) COMAND incl. DVD changer)
- Panoramic sliding sunroof control module (A98)
(with code (413) Panoramic glass sunroof with top sliding sunroof)
- Pneumatic pump for dynamic multicontour seat (M40/1)
(with code (432) Left and right dynamic multicontour seat)
- Front SAM control unit
- Automatic air conditioning control and operating unit (N22/7)
- Rear seat heater control unit (N25/6) (with code (872) Electrically heated left and right rear seats)
- Steering wheel heater control unit (N25/7)
(with code (443) Steering wheel heater)

- Special-purpose vehicle multifunction control unit (N26/9) (with code (965) Electrical preinstallation for rental vehicles)
- Trailer recognition control unit (N28/1) (with code (550) Trailer hitch)
- Driver seat control unit (N32/1) (with code (275) Memory package (driver seat, steering column, mirrors))
- Front passenger seat control unit (N32/2) (with code (242) Electrically adjustable front passenger seat with memory)
- Left front dynamic multicontour seat control unit (N32/19) (with code (432) Left and right dynamic multicontour seat)
- Right front dynamic multicontour seat control unit (N32/22) (with code (432) Left and right dynamic multicontour seat)
- Reversing camera control unit (N66/2) (with code (218) Reversing camera and code (498) Japan version)
- Left front door control unit (N69/1)
- Right front door control unit (N69/2)

- Left rear door control unit (N69/3)
- Right rear door control unit (N69/4)
- Keyless-Go control unit (N69/5) (with code (889) Keyless-Go)
- Overhead control panel control unit (N70) (with code (414) Power glass tilting/sliding sunroof)
- Electronic ignition switch control unit
- Weight sensing system (WSS) control unit (N110) (with code (494) USA version)
- Trunk lid control unit (N121) (model 212.0 with code (881) Remote trunk closing (RTC [HDFS]))
- Liftgate control unit (N121/1) (model 212.2)

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

- Left front reversible emergency tensioning retractor (A76)
- Right front reversible emergency tensioning retractor (A76/1)
- Supplemental Restraint System control unit (N2/10)
- CDI control unit
- ME-SFI [ME] control unit

- Parking system control unit (N62) (with code (220) PARKTRONIC or code (230) Exclusive parking assist)
- Steering column tube module control unit (N80)
- Tire pressure monitor control unit (N88) (with code (475) Tire pressure monitor (premium))

If the interior CAN and chassis CAN 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 it and sends it over the chassis CAN to the control units connected to the chassis CAN.

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 to the control units connected to the chassis CAN. Closing the no-load current shutoff relay causes power to again be supplied via circuit 30g.

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.

- The antitheft alarm system (ATA [EDW]) is activated (with code (551) Antitheft alarm system (ATA [EDW])):
The waiting time timer is reset.
- The panic alarm is triggered (with code (763) Radio remote control with panic switch):
The waiting time timer is reset.
- Activation of stationary heater (with code (228) stationary heater):
The timer of the waiting time will be reset.

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

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.

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

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

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 As of 1.6.10 one of the front doors must be opened during a jump start procedure or during any testing in the workshop to enable the alternator management (except model 212.095), to change to the jump-starting procedure or the workshop mode and the alternator voltage to be increased to $U = 14.3$ V.

- 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.

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 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) serves as the measure for a sufficiently charged on-board electrical system battery.

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.

i If the battery output of the high voltage battery (A100g1) is very low ($P < 8$ kW) when starting the hybrid drive system on model 212.095/098/298, the starting capability can be brought about by an energy transfer from the 12 V on-board electrical system to the high-voltage on-board electrical system.

If, when the engine hood is open, an external charger is connected and the power electronics control unit (N129/1) measures voltage of more than $U = 12.8$ V in the 12 V-on-board electrical system, energy with a maximum power of $P = 500$ W is transferred over the on-board electrical system battery and the power electronics control unit to the high voltage on-board electrical system and the high-voltage battery is charged (with circuit 15 ON only).

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