SIEMENS

LMV52…
Burner management system for forced draft burners

LMV52.4…:
- COx supervision and control

User Manual

The LMV5 and this User Manual are intended for OEMs which integrate the LMV5 in their products!

☞ **Note!**
This documentation is only valid together with the LMV5... Basic Documentation P7550.

Based on the following software versions:

LMV50... :	V10.20
LMV51... :	V05.10
LMV51.3… :	V05.10
LMV52.2.. :	V05.10
LMV52.4... :	V10.20
Int. LR module:	V02.10
Int. VSD module:	V01.50
AZL52...:	V05.00
PLL52...:	V01.50

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2 Warning notes

Warning!
The safety, warning, and technical notes given in the Basic Documentation on the LMV5 (P7550) apply fully to the present document also!

To avoid injury to persons, damage to property or the environment, the following warning notes must be observed!

The LMV5 is a safety device! Do not open, interfere with or modify the unit. Siemens will not assume responsibility for any damage resulting from unauthorized interference!

3 Typographical conventions

Safety notes

This User Manual contains information which must be observed to ensure your personal safety and to prevent damage to equipment and property. The instructions and notes are highlighted by warning triangles and arrows and are presented as follows, depending on the hazard level:

Warning means that death, severe personal injury or substantial damage to property **can** occur if adequate precautionary measures are not taken.

Note draws your attention to **other information** about the product and its handling contained in other pieces of documentation.

Qualified personnel

Only **qualified personnel** are allowed to commission and operate the unit. Qualified personnel in the context of the safety-related notes contained in this document are persons who are authorized to commission, ground and tag devices, systems and electrical circuits in compliance with established safety practices and standards.

Correct use

Note the following:

The unit may only be used on applications described in the technical documentation and only in connection with third-party products and components approved or recommended by Siemens.

The products can only function correctly and safely if shipped, stored, set up and installed correctly, and operated and maintained as specified.

4 COx supervision and control

4.1 General

Note!
The COx sensor is not included in the Siemens AG scope of delivery.
OEM customer is responsible for checking that the sensor is suitable for the functions described below.

4.2 Compatibility of the COx functions

The new COx functions are available from the following software versions:
- PLL52 from software version V01.40
  (as this requires a supply air sensor temperature range of >400 °C).
- LMV52.4 from software version V10.10

4.3 Functioning principle of COx supervision

For the purpose of supervising the COx quantities during combustion, the LMV52.4 offers the option of connecting a COx measurement transducer to the PLL52.

The states of the COx measurement transducer switching output have the following meanings:
- Contact open: COx present
- Contact closed: No COx present

These are evaluated by the LMV52.4 when COx supervision is active.

When COx supervision is active, line breaks, faults in the PLL52, and faults in the bus communication between the LMV52.4 and PLL52 result in a safety shutdown. This is also the case during O2 trim control.

Warning!
The connections of the COx sensor to the LMV52.4, and the COx functions in the LMV52.4, are not established in a fail-safe manner.

4.4 Hardware prerequisite / Connection diagram

The following hardware is required for COx supervision with LMV52.4:

- COx sensor with a potential-free switching contact (NO contact).
  The COx limit value at which the contact switches is defined in the COx measurement transducer.
- The COx sensor must be suitable for the fuels being used.
- The PLL52, input X87 must be available for the COx sensor connection:
  - For this, the supply air temperature sensor for calculating the firing efficiency can, alternatively, be connected to input X60 of the load controller and *activated* by means of the PLL52 parameter *AirTempX60PT1000*.

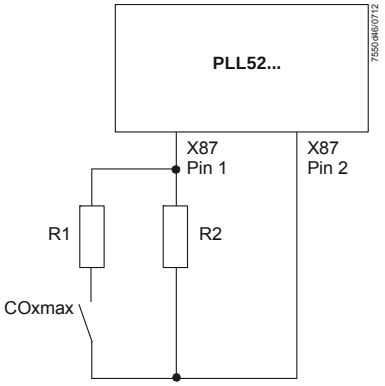
Parameter	*AirTempX60PT1000 (deactivated, **activated**)*

- The *Startmode* parameter for O2 trim control must be set to *standard* or *IgnPtWoutTC,* as all other start modes require a temperature sensor at input X87 of the PLL52. In terms of the CO functions, we recommend using the *standard* start mode only.

Parameter	*Startmode (**standard**, Ign Load TC, IgnPtWithTC, **IgnPtWoutTC**)*

- If input X87 on the PLL52 is used to connect the COx sensor, the PLL52 parameter *SupAirTempSens* must be set to *Pt1000.*
- COx control is only possible as of PLL52 software version V01.40, as this requires a temperature range for the supply air temperature sensor of >400 °C.

Suggested wiring



- Resistor R1: 7.15 kΩ (±10%)
- Resistor R2: 3.6 kΩ (±10%)

- Relay in no-load status: COx threshold exceeded
- Relay switched: COx threshold not achieved

4.5 Operating modes of COx supervision

With the *OptgMode COx* parameter, one of the two COx operating modes *COx Alarm* or *COx Control* can be set, and the COx functions *deactivated.*

Parameter	Gas: *OptgMode COx (deactivated / COx Alarm / COx Control)*
	Oil: *OptgMode COx (deactivated / COx Alarm / COx Control)*

4.5.1 *COx Alarm* operating mode

For straightforward supervision of the COx value, the parameter *OptgMode COx* must be set to *COx Alarm.*

Phases of COx alarm:

- Once prepurging is complete (upon entering phase 36), a single check is performed to determine whether a COx signal is present.
  If a COx signal is present, the fault response takes place immediately.
- In the operating phases (60, 62), checks are performed continuously to determine whether a COx signal is present after a waiting time has elapsed (*NumberTauSuspend * Tau Low-Fire*).
  If the COx signal is then present for longer than the parameterizable time *COx Alarm,* the fault response takes place.

Fault response:
A safety shutdown is performed with a new startup and, depending on the *O2 trim controller* repetition counter, lockout takes place.

Parameters:
The waiting time referred to above for the *COx Alarm* is dependent on the *Tau Low-Fire* time constant determined by O2 trim control, and can be set using the *NumberTauSuspend* parameter as a multiple of *Tau Low-Fire*:

Parameter	*NumberTauSuspend (0..140) * Tau Low-Fire)*

Permissible time for a COx signal to reach in the operating phases (60 and 62) before the fault response takes place:

Parameter	*Time COx Alarm (0..600s)*

Note!
If prepurging is skipped, the COx value is not checked in this section of the startup process.

Note!
The *NumberTauSuspend* parameter is also used as the locking time for O2 trim control.

Note!
The sampling time of the COx signal is approximately 3 seconds.
This must be taken into account when setting the test time *Time COx Alarm* e.g., for a required maximum response time of 10 seconds, the parameter must be set to 7 seconds.

Warning!
As the connections of the COx sensor to the LMV52.4, and the COx functions in the LMV52.4, are not established in a fail-safe manner, use the COx supervisory function always in conjunction with the O2 alarm function.

4.5.2 *COx Control* operating mode

This operating mode is only implemented for modulating operation.
The function is not available in multi-stage oil operation.
In addition, the O2 trim control function must be activated (O2 trim controller operating modes: *O2 Control* or *conAutoDeac*).

This operating mode is activated by setting the *OptgMode COx* parameter to *COx Control.*

Parameter	Gas: *OptgMode COx (deactivated / COx Alarm / COx Control)*
	Oil: *OptgMode COx (deactivated / COx Alarm / COx Control)*

In addition to COx supervision, the O2 value (an air supply) is then increased by means of the O2 trim control function if a COx signal is present during operation.
This is not a conventional COx control (with a COx setpoint, actual value, and control difference), but instead is an O2 trim control effect in relation to the COx value.
COx supervision takes place in the same way as in the *COx Alarm* operating mode.

Phases of COx control:
The COx controller is active in the operating phases (60, 62).
COx control is released at the same time as O2 trim control.

Value of the O2 increase:
The *O2ModOffset* parameter for the relevant fuel is used to specify how much the O2 value increases.
This is the same parameter as the one already used to increase the O2 value in the case of *fast* load changes (see chapter *Increasing the manipulated variable in case of fast load changes* in the LMV5 Basic Documentation (P7550)).

4.6 Increasing the manipulated variable in case of COx signal (*O2ModOffset*, formerly *O2Offset*)

If the COx maximum value is exceeded, the contact is closed (see chapter *Hardware prerequisite / Connection diagram*).
In order to prevent this, the user can use parameters to set an offset for the O2 value in the event that a COx signal occurs.
The next increase can only be made once the locking time has elapsed (waiting time of 2 x *Tau current load*).

There will be no increase of the O2 value when O2 trim control is deactivated.

The parameter defines the increase of the O2 value in %.

Example:
O2ModOffset = 0.8%, O2 actual value 1.4% ⇨ In the event of COx signal, the O2 value reached will be 2.2%.

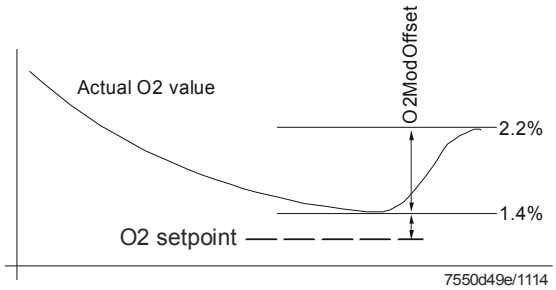


Figure 1: Increasing the manipulated variable in the case of a COx signal

Parameter	Gas: *O2ModOffset (0..5%)*
	Oil: *O2ModOffset (0..5%)*

Fault response:
The test time *Time COx Alarm* is started at the same time as the O2 value is increased. Once the test time is complete, and if the COx signal is still present in spite of increasing the air supply, a fault response takes place in the form of a safety shutdown with new startup and, depending on the *O2 Control* repetition counter, lockout is performed.

Parameter	*Time COx Alarm (0..600 s)*

4.7 Setting notes

(Summary of the most important rules for setting COx control)

4.7.1 Parameterizations

- **Parameterize all truly air-regulating actuators as such**
  If the parameter settings are changed, O2 trim control must be readjusted
- First of all, the O2 trim control must be set with deactivated COx sensor (see chapter *Operating modes of COx supervision*)

Parameter	*OptgMode COx Gas (deactivated, COx Alarm, COx Control)*

4.7.2 Setting fuel-air ratio control

Caution!

- **Set sufficient excess O2**
  Set the amount of excess air of the ratio control curve such that, whatever the environmental conditions (combustion chamber and fuel pressure, temperature and pressure of the combustion air), the set residual O2 content will lie above the O2 setpoints required by O2 trim control.

Example:

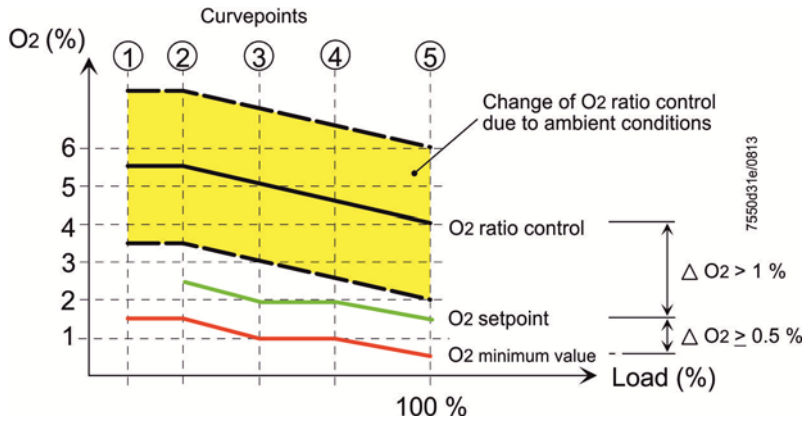


Figure 2: Setting fuel-air ratio control

- **Parameterized load proportional to the fuel rate**
  The burner load parameterized at the curvepoints must be proportional to the actual burner load. To make the correct setting, determine the burner load with the help of the fuel meter.
- **Curvepoint 1**
  The first curvepoint should have an adequate distance below curvepoint ②. This means that the curve for reducing the air rate is also defined below point ②. As a guide value, point ① should lie at about half the load of point ②. Point ② should be smaller than or equal to the low-fire load.

Note!
The following values can be entered at the AZL52... from software version V05.00 for the LMV52.2... and software version V10.10 for the LMV52.4...:

- Δ (O2 ratio control - O2 setpoint) ≥0.1%
- Δ (O2 setpoint - *O2 min value*) ≥0.1%

4.7.3 Setting the O2 trim controller

Setting the O2 min. value
The O2 min. value should be set as low as possible to ensure a high level of availability.

Caution!
Above or at the O2 min. value, hazardous conditions must not permanently occur.

Guide values: CO = 2,000 ppm, soot number 3.
The values can vary, depending on the type of plant.

- **Adequate distance between O2 setpoint and O2 min. value**
  The distance should be a minimum of 1...1.5% O2. If a smaller distance is used, the ratio control curve must be set as accurately as possible, in accordance with chapter *Setting notes- Setting fuel-air ratio control*.

- **All O2 setpoints must be adjusted under the same environmental conditions**
  It is important to adjust the O2 setpoints at the same ambient temperatures. If, later, individual setpoints are changed, all setpoints of the curvepoints must be readjusted since environmental conditions will probably be different from those at the time the initial settings were made.

4.7.4 Setting the COx supervision

Note!
The OEM customer is responsible for setting the COx sensor system.

Set the following parameters as described in the chapter *Operating modes of COx supervision*:

Parameter	*NumberTauSuspend (5..140)*
	Time COx Alarm (0..600 s)
	O2ModOffset (0..5%) (only in COx controller mode)

The function is activated as alarm or controller with the parameter *OptgMode COx Gas*.

Parameter	*OptgMode COx Gas (deactivated, COx Alarm, COx Control)*

4.8 Display on the AZL52

If a COx signal occurs, a notification is output on the AZL52.
The notification is automatically deleted if no further COx signals are present.

4.9 Displaying the O2 trim controller status

Also refer to the chapter *Displaying the O2 trim controller status* in the LMV5 Basic Documentation (P7550).

The status of the O2 trim controller can be read out with the AZL52 via data point *State O2 Ctrl*.

deactivated	The O2 trim controller is not active. The system operates along the ratio control curves.
locked	The manipulated variable of the O2 trim controller is held at the last value.
LockTStart	Locking time following startup until the O2 trim controller is initialized or released. The locking time is necessary in order to ensure that the actual O2 value is measured. The O2 trim controller is still deactivated or locked
InitContr	The O2 trim controller is initialized. The O2 trim controller is locked.
LockTLoad	The O2 trim controller is locked due to a load change.
active	The O2 trim controller is active and operates to the O2 setpoint.
LockTCAct	If switching functions (control interventions by the O2 trim controller) are active, the O2 trim controller is locked for 2 x Tau.
LockCOx	If the manipulated variable is affected due to the COx signal, the O2 and COx controllers are locked.

Process data display values	*State O2 Ctrl (deactivated, locked, LockTStart, InitContr, LockTLoad, active, LockTCAct, LockCOx)*

5 List of error messages of LMV5 system

Error code	Diagnostic code	Device	Display	Meaning for the LMV5 system	Troubleshooting
B6	#	LMV5		COx alarm error messages	
B6	*01*	*LMV5*	*COx value invalid*	*COx signal is not within the defined range of values or there is a cable break.*	*Check connection between the COx sensor and PLL52, check cable connection on the PLL52 basic unit, correct resistance dimensioning*
B6	*02*	*LMV5*	*COx monitoring time COx alarm undefined*	*No valid value has been entered in the parameter Time COx Alarm*	*Set Time COx Alarm parameter correctly*
B6	*03*	*LMV5*	*COx monitoring time constant Tau undefined*	*Missing path time constant*	*Perform adaption of O2 trim control, Tau Low-Fire and / or Tau High-Fire have no valid value*
B6	*04*	*LMV5*	*COx limit exceeded in operation*	*COx indicated by COx sensor*	*Optimize combustion settings*
B6	*05*	*LMV5*	*COx limit exceeded in prepurge*	*COx indicated by COx sensor*	*Optimize combustion settings*
B7	#	LMV5		PLL52 error during active COx supervision	
B7	*00..3E*	*LMV5...*	*COx supervision No valid COx signal from PLL52*	*Error messages from the PLL52... when COx supervision is active*	*Check the supply air temperature at the connection (short-circuit, open-circuit) Check the ambient temperature*
B7	*01*	*O2M*	*No valid COx signal from PLL52*	*CRC fault during ROM test*	*If fault occurs sporadically: Improve EMC. If fault occurs constantly: Replace the defective O2 module*
B7	*02*	*O2M*	*No valid COx signal from PLL52*	*CRC fault during RAM test*	*If fault occurs sporadically: Improve EMC. If fault occurs constantly: Replace the defective O2 module*
B7	*04*	*O2M*	*No valid COx signal from PLL52*	*Fault during key value check*	*If fault occurs sporadically: Improve EMC. If fault occurs constantly: Replace the defective O2 module*
B7	*05*	*O2M*	*No valid COx signal from PLL52*	*Error code for time block overflow*	*If fault occurs sporadically: Improve EMC. If fault occurs constantly: Replace the defective O2 module*
B7	*07*	*O2M*	*No valid COx signal from PLL52*	*Sync fault or CRC fault*	*If fault occurs sporadically: Improve EMC. If fault occurs constantly: Replace the defective O2 module*
B7	*08*	*O2M*	*No valid COx signal from PLL52*	*Error code for main loop counter*	*If fault occurs sporadically: Improve EMC. If fault occurs constantly: Replace the defective O2 module*
B7	*09*	*O2M*	*No valid COx signal from PLL52*	*Fault during stack test*	*If fault occurs sporadically: Improve EMC. If fault occurs constantly: Replace the defective O2 module*
B7	*0A*	*O2M*	*No valid COx signal from PLL52*	*Feedback values invalid*	*If fault occurs sporadically: Improve EMC. If fault occurs constantly: Replace the defective O2 module*
B7	*10*	*O2M*	*No valid COx signal from PLL52*	*Nernst voltage outside the valid range*	*Check the connection (correct polarity, short-circuit)*
B7	*12*	*O2M*	*No valid COx signal from PLL52*	*Thermo couple voltage outside the valid range*	*Check connections (polarity, short-circuit, open-circuit). Check power supply to the O2 module. Check fuse F2 on the O2 module. Check heating control on the QGO.*

Error code	Diagnostic code	Device	Display	Meaning for the LMV5 system	Troubleshooting
B7	*13*	*O2M*	*No valid COx signal from PLL52*	*Compensation element voltage outside the valid range*	*Check connections (polarity, short-circuit, open-circuit).* *Check housing temperature of the QGO (temperature inside -25...120 °C)*
B7	*15*	*O2M*	*No valid COx signal from PLL52*	*Temperature of combustion air sensor outside the valid range (-20...+800 °C)*	*Check the connection (correct polarity, short-circuit)* *Check ambient temperature*
B7	*16*	*O2M*	*No valid COx signal from PLL52*	*Temperature of flue gas sensor outside the valid range (-20...+800 °C)*	*Check the connection (correct polarity, short-circuit)* *Check ambient temperature*
B7	*17*	*O2M*	*No valid COx signal from PLL52*	*Fault during combustion air sensor test*	*If fault occurs sporadically: Improve EMC.* *If fault occurs constantly: Replace the defective O2 module*
B7	*18*	*O2M*	*No valid COx signal from PLL52*	*Fault during thermo couple test*	*If fault occurs sporadically: Improve EMC.* *If fault occurs constantly: Replace the defective O2 module*
B7	*19*	*O2M*	*No valid COx signal from PLL52*	*Fault during compensation element test*	*If fault occurs sporadically: Improve EMC.* *If fault occurs constantly: Replace the defective O2 module*
B7	*1A*	*O2M*	*No valid COx signal from PLL52*	*Fault during channel comparison of O2 signal*	*If fault occurs sporadically: Improve EMC.* *If fault occurs constantly: Replace the defective O2 module*
B7	*1B*	*O2M*	*No valid COx signal from PLL52*	*Fault ADC test voltages*	*If fault occurs sporadically: Improve EMC.* *If fault occurs constantly: Replace the defective O2 module*
B7	*20*	*O2M*	*No valid COx signal from PLL52*	*Temperature of QGO measuring cell too low*	*Check mains power supply on O2 module.* *Check fuse F2 on O2 module.* *Check connection between O2 module and QGO heating*
B7	*21*	*O2M*	*No valid COx signal from PLL52*	*Temperature of QGO measuring cell too high*	*Check QGO temperature*
B7	*22*	*O2M*	*No valid COx signal from PLL52*	*Fault during calculation test*	*If fault occurs sporadically: Improve EMC.* *If fault occurs constantly: Replace the defective O2 module*
B7	*23*	*O2M*	*No valid COx signal from PLL52*	*Measured internal resistance of the QGO measuring cell is smaller than 5 Ohm or greater than 150 Ohm*	*Check the connection (correct polarity, short-circuit)* *If fault occurs after more than 1 year, QGO may have reached the end of its service life* *→ Replace QGO*
B7	*24*	*O2M*	*No valid COx signal from PLL52*	*Measured response time of the QGO measuring cell exceeds 5 seconds*	*Check mounting position of QGO.* *Check to see if QGO is dirty.* *If fault occurs after more than 1 year, QGO may have reached the end of its service life* *→ Replace QGO*
B7	*25*	*O2M*	*No valid COx signal from PLL52*	*Fault occurred during O2 sensor test*	*Check fluctuations of the O2 value*
B7	*30*	*O2M*	*No valid COx signal from PLL52*	*CAN fault*	*If fault occurs sporadically: Improve EMC.* *If fault occurs constantly: Replace the defective O2 module*

Error code	Diagnostic code	Device	Display	Meaning for the LMV5 system	Troubleshooting
B7	*31*	*O2M*	*No valid COx signal from PLL52*	*CRC fault of a parameter page*	*Reset the unit*  Attention! If fault occurred during parameterization: Check the parameters changed last. If fault cannot be rectified by the reset: Restore parameters from AZL5. Otherwise, replace the O2 module
B7	*32*	*O2M*	*No valid COx signal from PLL52*	*Page too long open*	*Reset the unit*  Attention! If fault occurred during parameterization: Check the parameters changed last. If fault cannot be rectified by the reset: Restore parameters from AZL5. Otherwise, replace the O2 module
B7	*33*	*O2M*	*No valid COx signal from PLL52*	*Page disrupted*	*Reset the unit*  Attention! If fault occurred during parameterization: Check the parameters changed last. If fault cannot be rectified by the reset: Restore parameters from AZL5. Otherwise, replace the O2 module
B7	*34*	*O2M*	*No valid COx signal from PLL52*	*Invalid access to parameters*	*Reset the unit*  Attention! If fault occurred during parameterization: Check the parameters changed last. If fault cannot be rectified by the reset: Restore parameters from AZL5. Otherwise, replace the O2 module

Error code	Diagnostic code	Device	Display	Meaning for the LMV5 system	Troubleshooting
B7	*38*	*O2M*	*No valid COx signal from PLL52*	*Fault during copying of a parameter page*	*Reset the unit*  Attention! If fault occurred during parameterization: Check the parameters changed last. If fault cannot be rectified by the reset: Restore parameters from AZL5. Otherwise, replace the O2 module
B7	*3E*	*O2M*	*No valid COx signal from PLL52*	*External plausibility fault.* *This type of fault covers possible faults occurring due to invalid presettings in the drive commands. In response, the presettings will be ignored*	*Reset the unit*  Attention! If fault occurred during parameterization: Check the parameters changed last. If fault cannot be rectified by the reset: Restore parameters from AZL5. Otherwise, replace the O2 module
B7	*3F*	*O2M*	*No valid COx signal from PLL52*	*Internal plausibility fault.* *This type of fault covers possible errors that cannot practically occur*	*If fault occurs sporadically: Improve EMC.* *If fault occurs constantly: Replace the defective O2 module*
B7	*41*	*LMV5*	*No valid COx signal from PLL52*	*Cable connection to the PLL52 disconnected*	*Check CAN wiring / check power supply PLL52…*
B7	*42*	*LMV5*	*No valid COx signal from PLL52*	*PLL52 is sending messages but these are incorrect*	*Check cable connection / wiring to the PLL52*
BE	*01*	*LMV5*	*COx operating mode is not possible with the selected O2 operating mode*	*COx supervision must not be combined with the setting for a temperature-compensated start mode in O2 trim control. Both settings use the supply air sensor*	*Parameterize the O2 start mode to standard or to IgnPtWoutTC, or set COx supervision to deactivated.*

6 Revision history

Changes to the replacement release 2012 / 2013:

- **COx control with LMV52.4 and PLL52.**
  With the LMV52.4 (software version V10.20), COx control is available in conjunction with the PLL52, software version V01.40 and above (as the PLL52 requires a temperature range for the supply air temperature sensor of >400 °C).

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