# 'Controlling motor holding brake'

Translation of the "Original Dokumentation"
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| | |
|---|---|
| **Name:** | FKT_Ansteuerung_der_Motorhaltebremse_en |

**Version:**

| Version: 2019/45 | |
|---|---|
| **Change** | **Letter symbol** |
| • KW-R27 added | STL |

**Previous version:** 2018/44

**Product version:**

| Product (AMK part no.) | Firmware Version (AMK part no.) |
|---|---|
| KW-R06 (O835)<br>KW-R07 (O807)<br>KW-R16 (O872)<br>KW-R17 (O873) | AE-R05/R06 V1.16 2018/25 (207207) |
| KW-R24 (O901) | AE-R24 V2.02 2014/23 (205216) |
| KW-R24-R (O954) | AE-R24-R V2.11 2016/46 (206643) |
| KW-R25 (O902) | AE-R25 V2.12 2018/23 (206993) |
| KW-R26 (O903) | AE-R26 V2.12 2018/23 (206647) |
| KW-R27 (O957) | AE-R26 V2.12 2018/40 (207284) |
| iX / iC / iDT5 | iX V1.08 2016/04 (206178) |
| iX(-R3) / iC(-R3) /<br>iDT5(-R3) / | iX V2.12 2018/03 (207093) |
| ihX | ihX V2.12 2018/03 (207094) |

# 1 Activation of the motor holding brake

| Supported hardware: | KW-R06 / KW-R16 / KW-R07 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R24 / KW-R24-R / KW-R25 / KW-R26 / KW-R27 / |
|---|---|

| ⚠ DANGER | |
|---|---|
| ⚠ | **Risk of injury from hanging axes** |
| | The optional motor brake is a holding brake and does NOT provide sufficient protection for persons. |
| | Hanging axes can fall and lead to severe injury. |
| | **Steps to prevent:** |
| | • All hanging axes must be mechanically secured against falling with a fall arrester or a supplementary external brake, for instance. |
| | • People must not stand under hanging loads |

| NOTE | |
|---|---|
| **Material damage!** | **Driving mode with closed motor holding brake!** |
| | If the motor holding brake is closed, the drive must not turn, otherwise the motor holding brake can be damaged. On the application side, it must be determined whether the motor holding brake has opened properly. |

A motor holding brake fixes the motor shaft in the energy-free state, for example in an application with a hanging axis.

The 'Motor brake control' function opens and closes the motor holding brake automatically, taking into account the parameterized response times of the motor holding brake.

The motor holding brake is opened and closed automatically and timely by the drive controller in fault-free operation by setting and resetting RF (controller enable).

In principle, the drive controller needs a control deviation at the input before outputting output values. As long as the axis is fixed by the motor brake, the control can not establish a holding torque. As soon as the motor brake is opened, an axis which is under load moves and a control deviation is generated. To reduce the control deviation, the controller (I-component in the speed controller) builds a holding torque. The magnitude of the compensating movement after the brake is released depends on the set control parameters and the mechanical conditions.

The torque feed-forward control principle can be used to apply a starter torque that builds up immediately while the brake is opening. The better the feed-foreward torque is adapted to the load, the lower the initial axial movement. The torque feed-forward control value can be specified externally via parameter (ID81 'Additive torque command value') or with the functions 'load model'.

| Supported hardware: | iX(-R3) / iC(-R3) / iDT5(-R3) / KW-R25 / KW-R26 / KW-R27 / |
|---|---|

Code 33925 'Status of a connected brake' can be used to configure the status of a motor holding brake as a digital output or in ID144 'Status word'.

0: Motor holding brake closed

1: Motor holding brake opened

The bit only reflects a 'true' feedback from the motor holding brake when the brake provides a status signal and this status is configured to a digital input (code 33906). If this function not configured, 'Status of a connected brake' will supply the control signal, but with consideration of the delays ID206 ('Drive on delay time') and ID207 ('Drive off delay time').

**Behavior of the motor holding brake for different operating states**

| Operating state Drive | Control signal EF [1] STO [2] | Control signal RF | Manual activation [4]<br>• AIPEX PRO 'Direct mode'<br>• Digital input | Meaning |
|---|---|---|---|---|
| Drive free of error | 1 | 0 | Possible | Motor holding brake can be opened and closed manually. |
| Drive free of error | 0 | 0 | Not possible | A manual activation of the motor holding brake is not possible. Motor holding brake is closed. |
| Drive free of error | 1 | 0 → 1 | Possible [3] | Motor holding brake opens automatically. |
| Drive free of error | 1 | 1 → 0 | Possible | Drive brakes automatically. (ID32782 'Deceleration ramp RF inactive')<br>$N_{actual} < 6.5$ rpm<br>Motor holding brake is closed automatically.<br>Motor holding brake can subsequently be opened and closed manually. |
| Drive free of error | 1 → 0 | 1 | Not possible | Motor holding brake is closed immediately for locked output stage.<br>Drive generates an error message. |
| Error during operation<br>Drive behavior for error: Coasts down | 1 | 1 | Not possible | Motor holding brake closes when error occurs. |
| Error during operation<br>Drive behavior for error: Controlled braking | 1 | 1 | Possible | Drive brakes automatically. (ID32782 'Deceleration ramp RF inactive')<br>$N_{actual} < 6.5$ rpm<br>Motor holding brake is closed automatically.<br>Motor holding brake can subsequently be opened and closed manually. |

1) EF output stage enable

   Control signal EF = 1 output stage is enabled, motor can be energized

   Control signal EF = 0 output stage is locked, protection against restart active

2) STO (Safe torque off)

   Control signal STO = 0 (Status STO = active) output stage locked, protection against restart active

   Control signal STO = 1 (Status STO = not active) output stage is enabled, motor can be energized

3)

| | **NOTE** |
|---|---|
| | **Driving mode with closed motor holding brake!** |
| **Material damage!** | If the motor holding brake is closed, the drive must not turn, otherwise the motor holding brake can be damaged. On the application side, it must be determined whether the motor holding brake has opened properly. |

4) See 'Activating the motor holding brake manually' on page 1.

**Device-specific difference:**

**Meaning for KW-R06 / KW-R16 / KW-R07 / KW-R17 / KW-R24 / KW-R24-R / KW-R25 / KW-R26 / KW-R27 / iX / iC / iDT5 / iX (-R3) / iC(-R3) / iDT5(-R3) /**

Motor holding brakes, which output an acknowledgment signal, can be monitored for plausibility.

**Meaning for KW-R06 / KW-R16 / KW-R07 / KW-R17 / KW-R24 / KW-R24-R / KW-R25 / KW-R26 / KW-R27 /**

The connection of the motor holding brake can be monitored for cable breakage.

**Meaning for iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT /**

Output of a cycled supply voltage for the motor holding brake.

# 2 Central drives (KW/KWD)

## 2.1 Description of function

The function 'Activate motor holding brake' activates the digital output BA3 on the controller cards.

The digital output BA3 is assigned to the parameter (ID32867 'Port 3 Bit 2') and must be parametrized with the function code 33052 'Activation of the motor holding brake'.

**Monitoring digital output BA3 motor holding brake for cable breakage**

| NOTE | |
|---|---|
| **Material damage!** | **Activation of the motor holding brake**<br>The parametrized brake output is monitored for cable breakage (ID32901 Bit 7 = 1) and is not permitted to be connected with any other load than the motor holding brake. Load currents of 200 µA and higher (e.g. LED status displays) are detected as real loads and interpreted as a motor holding brake being connected correctly. |

The monitoring of the connection to the digital output BA3 motor holding brake for cable breakage must be switched on on the user side.

A test current is generated on the output BA3 at low condition (BA3 = 0 ) to exclude cable breakage. Only after an edge change a fault is outputted. In high condition (BA3 = 1) the current is monitored to ≠ 0. If one of these conditions failed the error message 1100 is generated.

Activate monitoring of motor holding brake for cable breakage: ID32901 'Global service bits' Bit 7 = 1
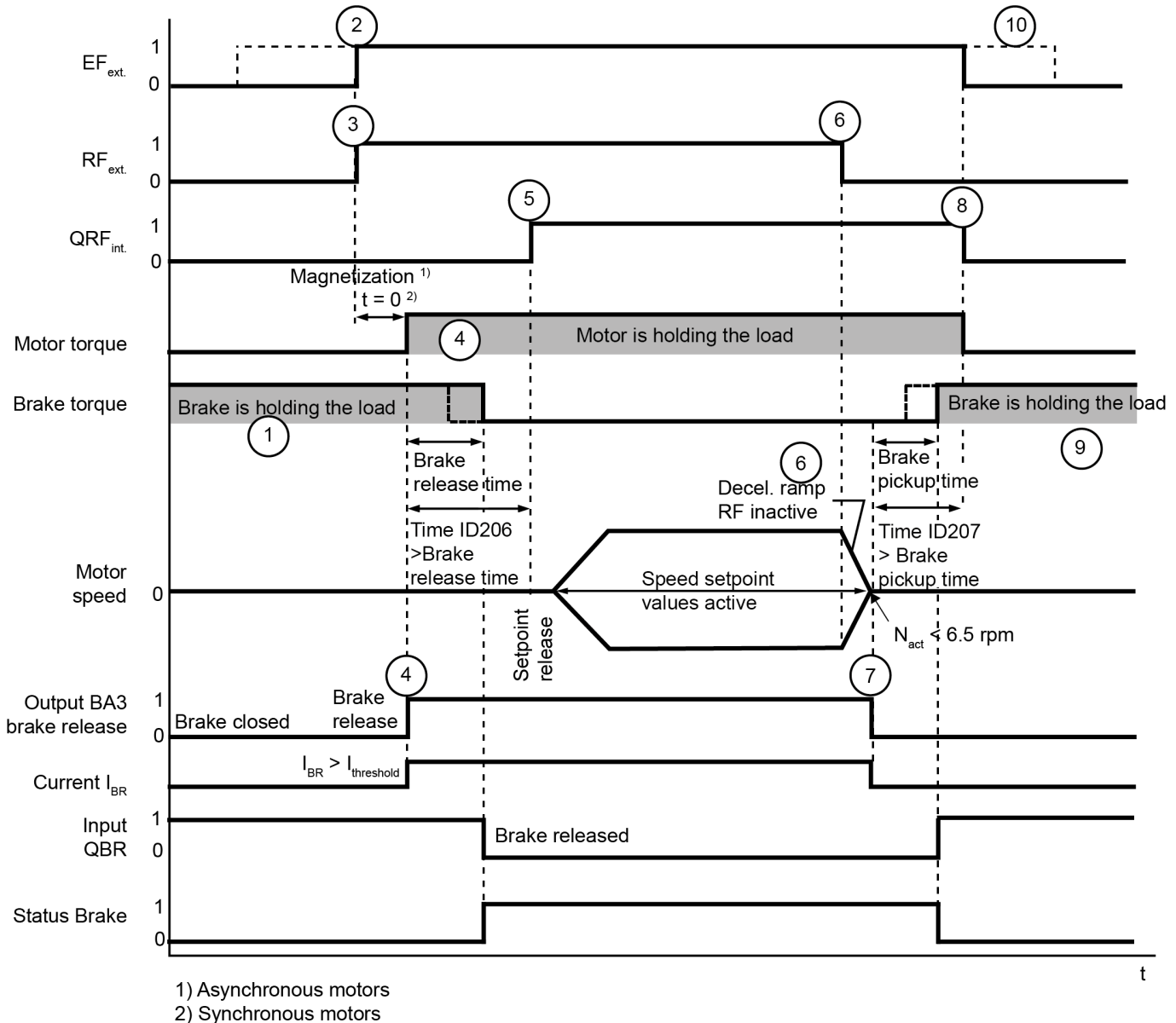
**Monitoring acknowledgment of the motor holding brake**

For motor holding brake with acknowledgment signal, the signal is to be wired with a digital input. The parameter assigned to the digital input must be parametrized with the function code 33906 'Acknowledgment signal motor holding brake (QBR)'. The monitoring function is switched on with ID32773 'Service bits' Bit 13.

If the acknowledgment signal is not plausible during operation, the error message 1071 is generated.

## 2.2 Time diagram

**Activation of the motor holding brake for switching on and shutting down**



1) Asynchronous motors
2) Synchronous motors

Sequence for switching on:

1. The motor holding brake is closed, the motor is energy-free
2. EF (output stage enable), the motor can be energized and the motor holding brake activated
3. RF (controller enable) on, the motor is energized
4. As soon as the brake opens, the motor is in control loop.

> ⓘ An initial control deviation and therefore movement of the axis is principle, but can be prevented by an additional torque pre-control on the application side.

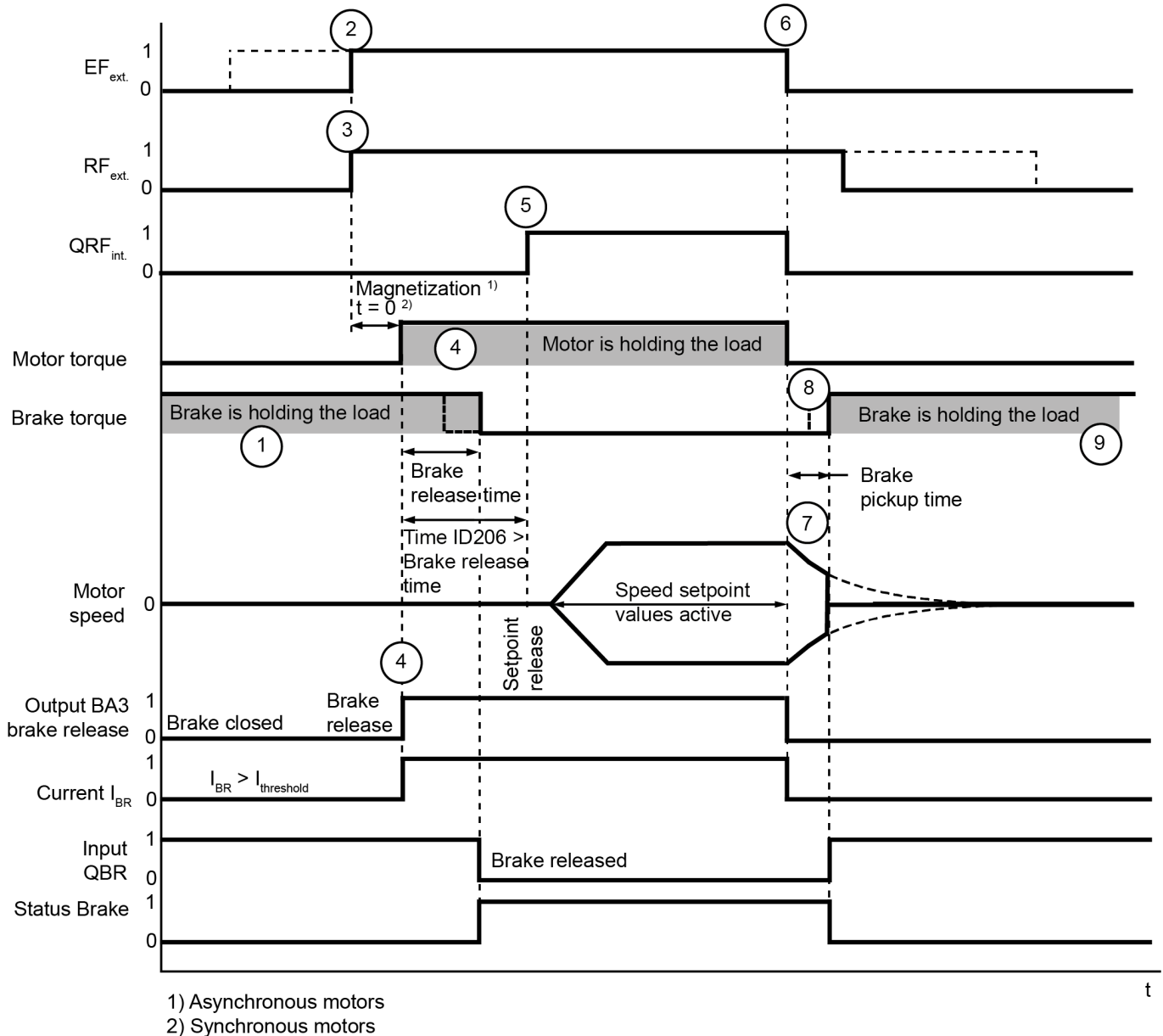5. The controller enable acknowledgment is set (QRF = 1) after the time has expired

> ⓘ The controller may only specify setpoints if the QRF is set, otherwise the drive works against the motor holding brake.

Sequence for switching off:

6. RF (controller enable) off, the deceleration (see ID32782 'Deceleration ramp RF inactive') is activated
7. $N_{act}$ < 6.5 rpm (axis halt), the motor holding brake is closed
8. The motor controller is deactivated after the time has expired in ID207,
   the motor is energy-free (acknowledgment controller enable QRF = 0)

9. The motor holding brake holds the position
10. EF (output stage enable) can be deactivated.
    EF = 0: activation of the motor holding brake is not possible

**Activation of the motor holding brake for deactivated output stage enable (EF)**



1) Asynchronous motors
2) Synchronous motors

Sequence for switching on:
1. The motor holding brake is closed, the motor is energy-free
2. EF (output stage enable), the motor can be energized and the motor holding brake activated
3. RF (controller enable) on, the motor is energized
4. As soon as the brake opens, the motor is in control loop.

   An initial control deviation and therefore movement of the axis is principle, but can be prevented by an additional torque pre-control on the application side.

5. The controller enable acknowledgment is set (QRF = 1) after the time has expired

   The controller may only specify setpoints if the QRF is set, otherwise the drive works against the motor holding brake.

Sequence for switching off for output stage enable (EF) inactive:

> **⚠ DANGER** — Falling load!
> The load is not held during the application time of the motor holding brake and is in freefall, if no other mechanical safety catch is installed.

6. On the user-side, the EF input is no longer supplied with 24 VDC
7. Internally, the controller enable is revoked and the drive coasts down.
8. The motor holding brake is no longer activated and drops after the application time
9. The motor holding brake holds the load after the motor holding brake is closed

## 2.3 Relevant parameters

| Parameter | Meaning / information |
|---|---|
| ID206 'Drive on delay time' | The 'Drive on delay time' defines the time between the output signal for controlling the motor holding brake and the acknowledgement controller enable (QRF) (brake opens). |
| ID207 'Drive off delay time' | The 'Drive off delay time' defines the time between the output signal for controlling the motor holding brake and the dropout of the acknowledgement controller enable (QRF) (brake is applied). |
| ID32773 'Service bits' Bit 13 | Monitoring acknowledgment of the motor holding brake (for motor holding brake with acknowledgment signal)<br>Bit 13 = 0: Monitoring inactive<br>Bit 13 = 1: Monitoring active |
| ID32864 'Address output port 3' | Code 544: Function assignment via parameter |
| ID32867 'Port 3 Bit 2' | Activation of the motor holding brake<br>Function code: 33052 |
| ID32901 'Global service bits' Bit 7 | Monitoring digital output BA3 motor holding brake for cable breakage<br>Bit 7 = 0: Monitoring inactive<br>Bit 7 = 1: Monitoring active |
| ID32978 'Port 3 Bit 0'<br>ID32979 'Port 3 Bit 1'<br>ID32980 'Port 3 Bit 2' | Acknowledgment of the motor holding brake (QBR)<br>Function code: 33906 |
|  | Manual activation of the motor holding brake via BE<br>Function code: 33735 |

**Code for the configuration of the digital outputs**

| Code | Meaning / information |
|---|---|
| 33052 | Controlling motor holding brake<br>BA3 = 0: Motor holding brake is closed by the drive<br>BA3 = 1: Motor holding brake is opened by the drive |
| 33925 | Status of a connected brake<br>0: Motor holding brake closed<br>1: Motor holding brake opened |

**Codes for the configuration of the digital inputs**

| Code | Meaning / information |
|---|---|
| 33735 | Manual control of the motor holding brake via digital input<br>0 → 1 edge: Open motor holding brake<br>1 → 0 edge: Close motor holding brake |
| 33906 | Acknowledgement motor holding brake (QBR)<br>QBR = 1: Motor holding brake closed<br>QBR = 0: motor holding brake opened<br>(QBR is supplied by the motor holding brake) |

# 3 Decentralized drives (iC / iX / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT)

## 3.1 Description of function

The function 'Activate motor holding brake' activates dedicated connections on the motor connector for the peripheral devices iC and iX.

In the peripheral devices iDT5 and ihXT, an optional motor holding brake is wired internally in the device.

**Cycled supply voltage for the motor holding brake**

The supply of the motor holding brake with a cycled voltage reduces the power loss of the motor holding brake.

When opening the motor holding brake, the device-specific activation times of the motor holding brake utilized in the motor must be taken into account. After the motor holding brake is opened, the voltage supply of the motor holding brake can be cycled. The clock ratio must be set in such a way that the motor holding brake remains open.

Do not cycle the motor holding brake if a motor fan is powered from the same supply.
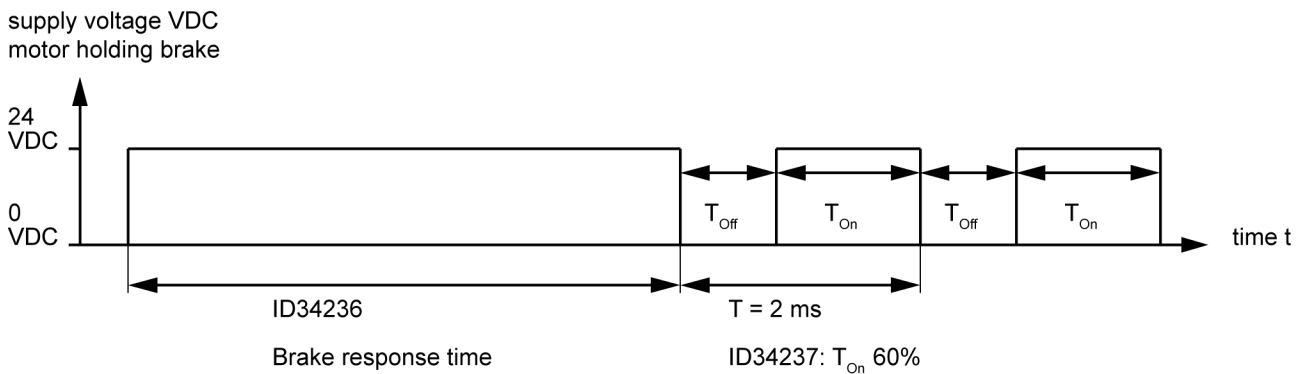


Example:

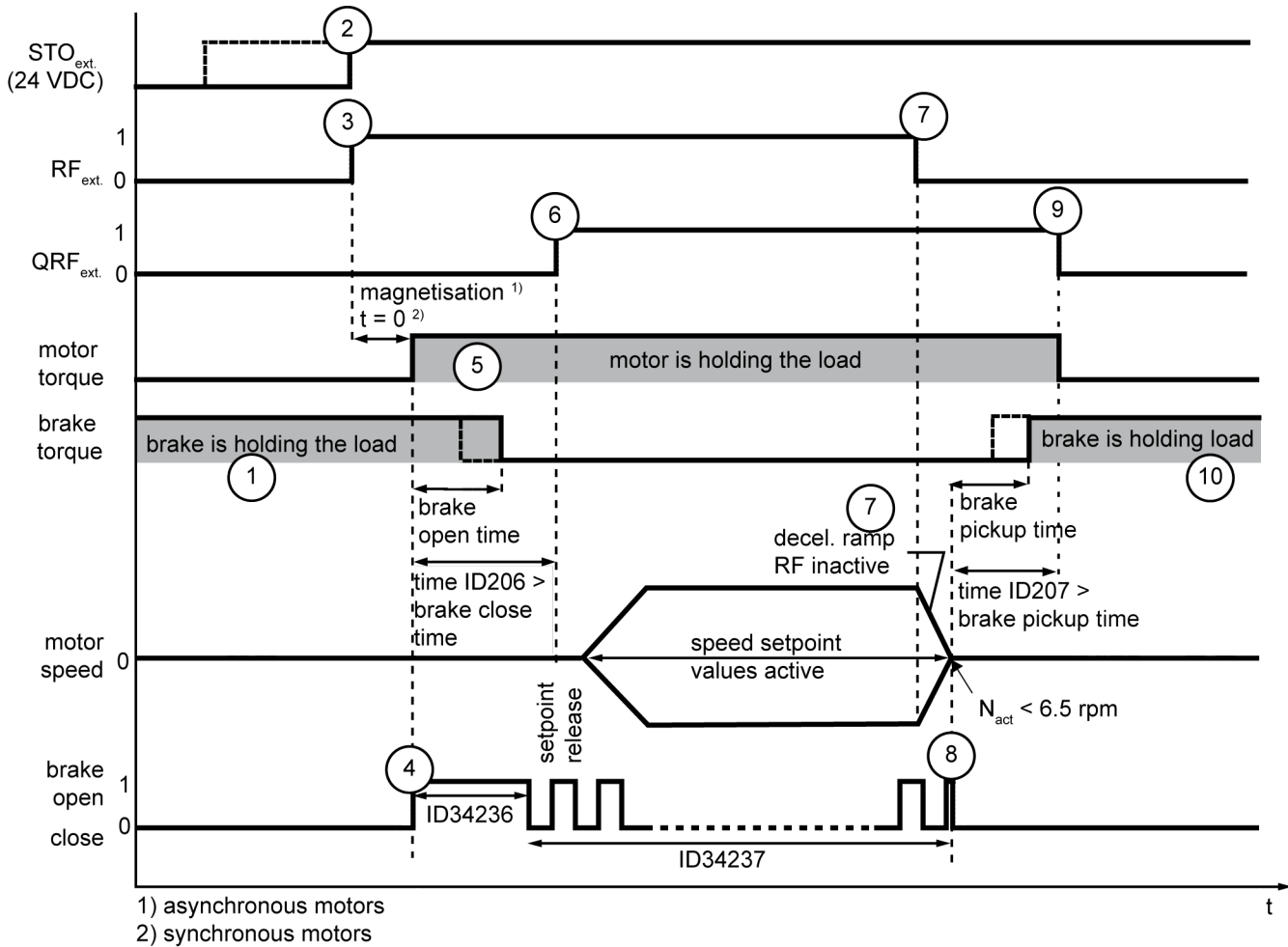| | |
|---|---|
| ID34165 'Holding torque brake' | = Value > 0 |
| ID34236 'Time motor brake on' | = Activation time of the motor holding brake depends on the holding brake utilized in the motor |
| ID34237 'Pulse duty factor motor brake' | = 60 % |

ID34237 'Pulse duty factor motor brake' is always based on a cycle duration of 2 ms.

$T_{On}$ = 60 % = 1.2 ms

$T_{Off}$ = 40 % = 0.8 ms

## 3.2 Time diagram

**Activation of the motor holding brake for switching on and shutting down**



1) asynchronous motors
2) synchronous motors

**Sequence for switching on:**

1. The motor holding brake is closed, the motor is energy-free
2. 24 VDC is applied, STO is deactivated, the motor can be energized and the motor holding brake activated
3. RF (controller enable) on, the motor is energized
4. The motor holding brake for the 'Time motor brake on' (ID34236) is activated (opened).
   ´The motor holding brake is cycled after the time has expired in ID34236
5. As soon as the brake opens, the motor is in control loop.

   ⓘ An initial control deviation and therefore movement of the axis is principle, but can be prevented by an additional torque pre-control on the application side.

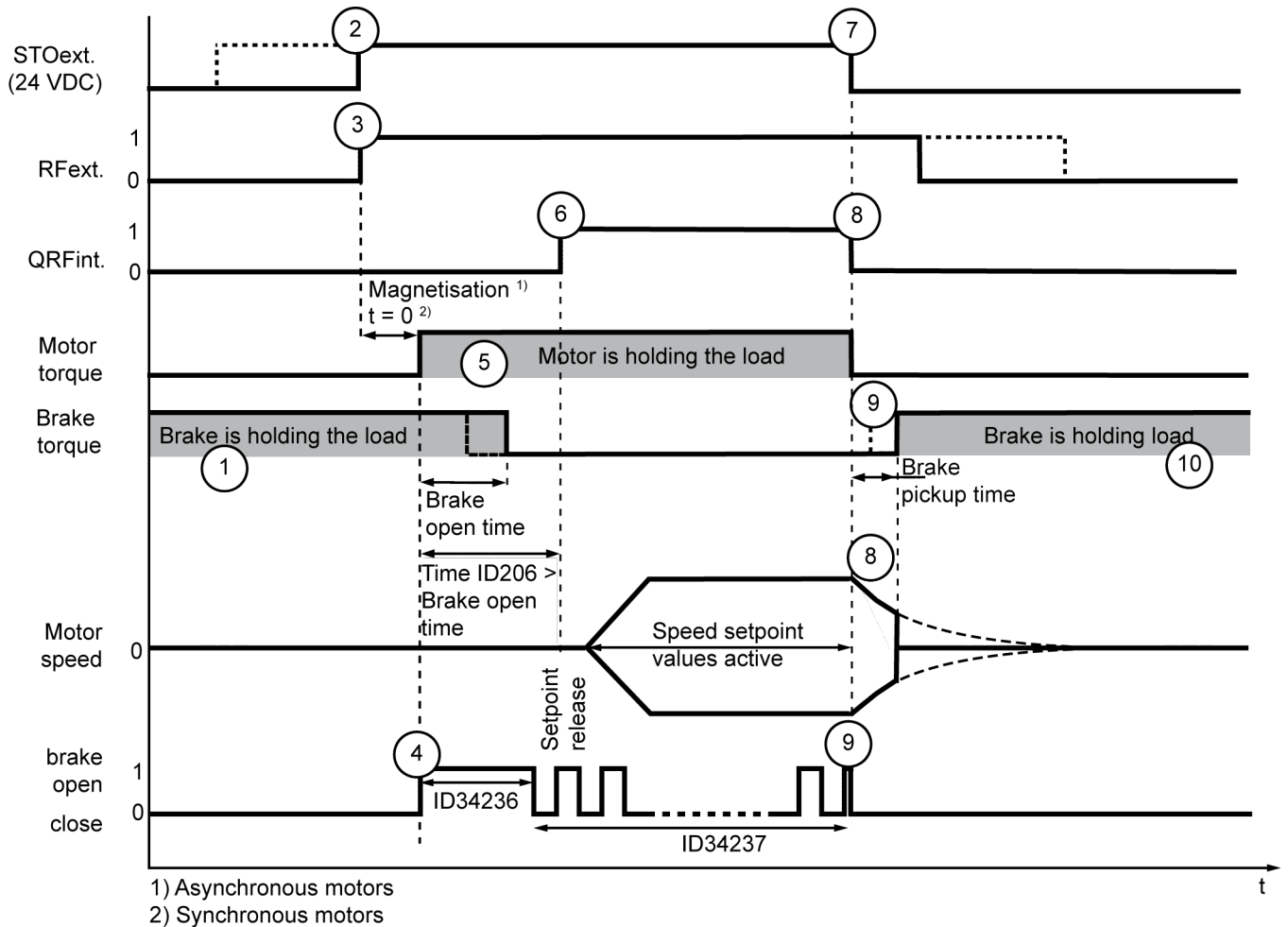6. The controller enable acknowledgment is set (QRF = 1) after the time has expired

   ⓘ The controller may only specify setpoints if the QRF is set, otherwise the drive works against the motor holding brake.

**Sequence for switching off:**

7. RF (controller enable) off, the deceleration (see ID32782 'Deceleration ramp RF inactive') is activated
8. $N_{act}$ < 6.5 rpm (axis halt), the motor holding brake is closed
9. The motor controller is deactivated after the time has expired in ID207,
   the motor is energy-free (acknowledgment controller enable QRF = 0)
10. The motor holding brake holds the position

**Activation of the motor holding brake for STO**



1) Asynchronous motors
2) Synchronous motors

Sequence for switching on:

1. The motor holding brake is closed, the motor is energy-free
2. 24 VDC is applied, STO is deactivated, the motor can be energized and the motor holding brake activated
3. RF (controller enable) on, the motor is energized
4. The motor holding brake for the 'Time motor brake on' (ID34236) is activated (opened).
   ´The motor holding brake is cycled after the time has expired in ID34236
5. As soon as the brake opens, the motor is in control loop.

   > An initial control deviation and therefore movement of the axis is principle, but can be prevented by an additional torque pre-control on the application side.

6. The controller enable acknowledgment is set (QRF = 1) after the time has expired

Sequence for switching off for STO:

**⚠ DANGER**   Falling load!
The load is not held during the application time of the motor holding brake and is in freefall, if no other mechanical safety catch is installed.

7. On the user-side, the STO input is no longer supplied with 24 VDC
8. Internally, the controller enable is revoked and the drive coasts down.
9. The motor holding brake is no longer activated and drops after the application time
10. The motor holding brake holds the load after the motor holding brake is closed

## 3.3 Relevant parameters

| Parameter | Meaning / information |
|---|---|
| ID206 'Drive on delay time' | The 'Drive on delay time' defines the time between the output signal for controlling the motor holding brake and the acknowledgement controller enable (QRF) (brake opens). |
| ID207 'Drive off delay time' | The 'Drive off delay time' defines the time between the output signal for controlling the motor holding brake and the dropout of the acknowledgement controller enable (QRF) (brake is applied). |
| ID32773 'Service bits' Bit 13 | Meaning for iX / iC:<br><br>Monitoring acknowledgment of the motor holding brake (for motor holding brake with acknowledgment signal)<br><br>Bit 13 = 0: Monitoring inactive<br><br>Bit 13 = 1: Monitoring active |
| ID32978 'Port 3 Bit 0'<br>ID32979 'Port 3 Bit 1'<br>ID32980'Port 3 Bit 2' | Acknowledgment of the motor holding brake (QBR)<br><br>Function code: 33906 |
| ID34165 'Holding torque brake' | If the motor contains an 'electronic nameplate' and an integrated motor holding brake, ID34165 'Holding torque brake' will be read automatically. Otherwise the holding torque of the brake must be entered by hand.<br><br>If ID34165 = 0<br>The controlling of motor holding brake is deactivated |
| ID34236 'Time motor brake on' | The 'Time motor brake on' determines how long the motor brake is provided with a constant 24 V DC for opening. After the 'Time motor brake on' has expired, the opened brake is supplied with a pulsed voltage. |
| ID34237 'Pulse duty factor motor brake' | The 'Pulse duty factor motor brake' determines the clock ratio $T_{On}/T$ with which the opened brake is supplied (T = 2 ms, not changeable) |

**Code for the configuration of the digital outputs**

| Code | Meaning / information |
|---|---|
| 33925 | Status of a connected brake<br><br>0: Motor holding brake closed<br><br>1: Motor holding brake opened |

**Codes for the configuration of the digital inputs**

| Code | Meaning / information |
|---|---|
| 33906 | Acknowledgement motor holding brake (QBR)<br><br>QBR = 1: Motor holding brake closed<br><br>QBR = 0: motor holding brake opened<br><br>(QBR is supplied by the motor holding brake) |
| 33735 [1] | Manual control of the motor holding brake via digital input<br><br>0 → 1 edge: Open motor holding brake<br><br>1 → 0 edge: Close motor holding brake |

[1] The function code can be used with the ihXT in conjunction with a virtual digital input.

# 4 Activating the motor holding brake manually

| ⚠ DANGER |
|---|
| **Risk of injury from hanging axes** |
| The optional motor brake is a holding brake and does NOT provide sufficient protection for persons. |
| Hanging axes can fall and lead to severe injury. |
| **Steps to prevent:** |
| • All hanging axes must be mechanically secured against falling with a fall arrester or a supplementary external brake, for instance. |
| • People must not stand under hanging loads |

During, e.g. the startup, the motor holding brake can be opened and closed manually via the following versions:
- Digital input
- AIPEX PRO 'Direct mode'

On the user side it must be ensured that the motor holding brake is not simultaneously activated via different versions.

The motor holding brake can only be opened if the 24 VDC supply voltage for the logic and the motor holding brake is present on the device.

**Digital input version**

Digital inputs can be assigned digital input functions.

| | |
|---|---|
| Digital input function | : Code 33735 'Motor holding brake activation' |
| Digital input state | : 0 → 1: Open motor holding brake |
| | 1 → 0: Close motor holding brake |

**AIPEX PRO 'Direct mode' version**

Start the AIPEX PRO 'Direct mode'

1. Select the available connection. Status 'green' means connection active.

2. Select the device that you want to access

3. Select the 'Special functions' menu

4. The motor holding brake is activated with the 'Release brake' and 'Fix brake' buttons

5. Status of the function