

BTM90xx

Frequently asked questions

About this document

Scope and purpose

This document compiles frequently asked questions on BTM90xx and provides solutions to common problems that can occur during the development. This document is to be used in conjunction with the device datasheets, which contain full technical details, specifications, and description of operation.

Intended audience

Developers working with the BTM90xx.

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1 Introduction to the device BTM90xx

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The BTM90xx device is a MOTIX™ full-bridge *integrated circuit (IC)* for automotive brushed *direct current (DC)* motor drive applications, such as door modules, mirror modules, and body control modules. This monolithic device is implemented in Bipolar-CMOS-DMOS (BCD) technology. The device provides intelligent protection features against overtemperature, undervoltage, overcurrent, short circuits, and crosscurrent. The device also provides current sense and open load diagnostic features. The output current and the error flag is presented on the IS pin.

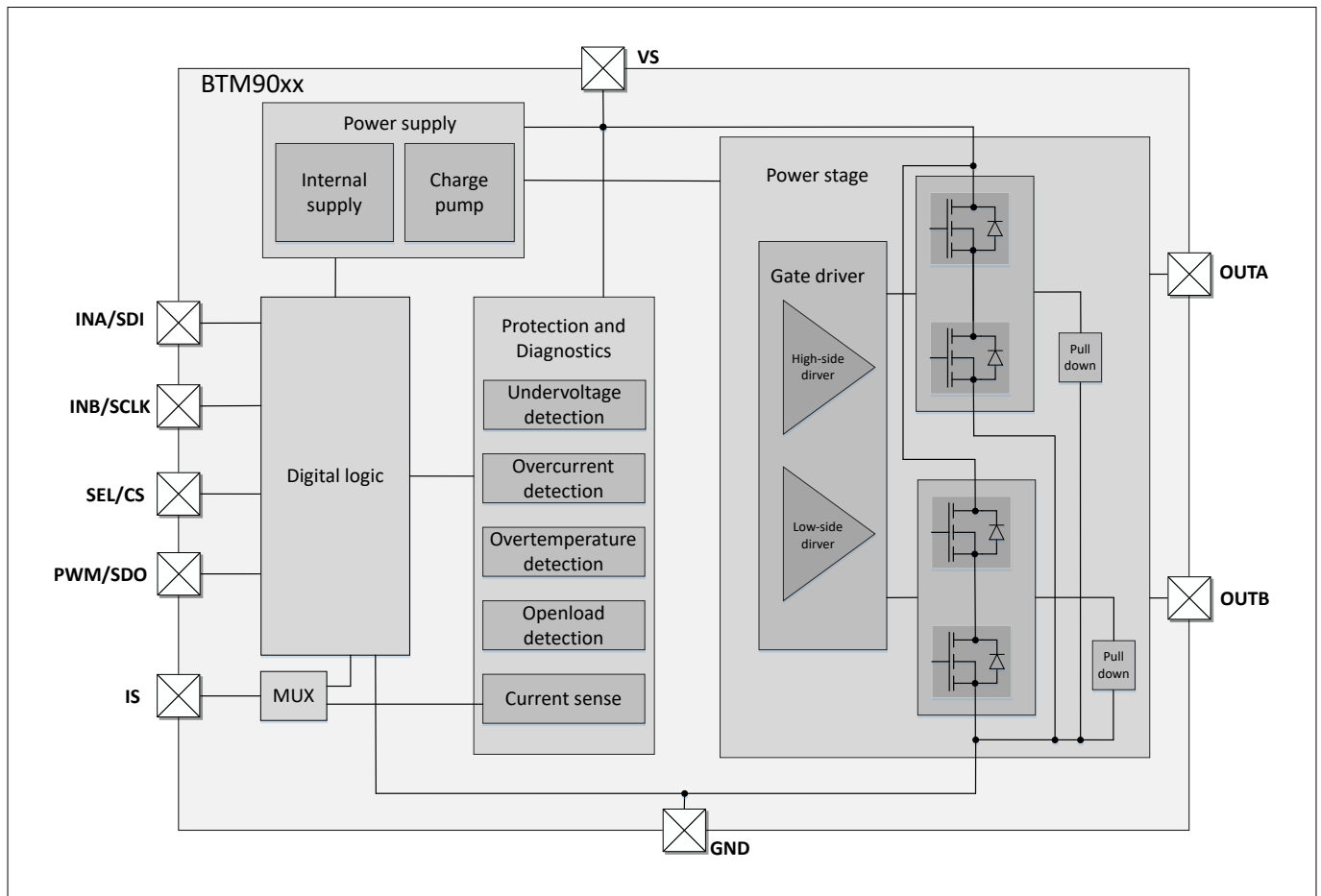


Figure 1 BTM90xx block diagram

2 Frequently asked questions

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2.1 How do I drive a DC motor with PWM?

The BTM90xxEP device has four inputs (INA, INB, *pulse-width modulation (PWM)*, and SEL) to configure the full-bridge, where both the following apply:

- SEL defines current sense on which half-bridge (HB): When SEL = 0, current flowing on HBB is sampled; when SEL = 1, current flowing on HBA is sampled
- INA, INB and PWM inputs together defines state of HS and LS on HBA and HBB. For more information, refer to Table 7 in the datasheet

Note: The rules do not apply to frames defined in Table 8 in the datasheet.

Application example:

A brushed *DC* motor is connected between OUTA and OUTB. The target is to enable LSA and HSB to energize the motor, and enable LSA and LSB for active *freewheeling (FW)*. The device samples the current flowing on HSB. To achieve the control target, the settings below are applied sequentially to the device:

1. Motor acceleration: INA, INB, PWM, SEL = 0110: LSA & HSB ON, current sense on HSB
2. Active FW: INA, INB, PWM, SEL = 0010: LSA & LSB ON, current sense on HSB

As shown above, the INB input is updated.

In real applications, define the work-case first and consult Table 7 in the datasheet for the corresponding settings.

2.2 How do I select the best-fit device for the application?

BTM90xxEP devices have four variants:

- BTM9010EP and BTM9020EP are with direct inputs
- BTM9011EP and BTM9021EP are with *serial peripheral interface (SPI)* interfaces

When selecting devices, consider the following aspects based on the application:

- SPI or direct input
- Current profile of the load (sometimes further verification with thermal simulation is required)
- Required *PWM* frequency
- Accuracy of current sense

Table 1 BTM90xxEP feature comparison

	BTM901xEP	BTM902xEP
Path resistance	175 mΩ at 25°C	85 mΩ at 25°C
Current limitation	Min. 10 A	Min. 20 A
Register enable bit	BTM9011EP has a enable bit to enable & disable the device	No enable bit
Watchdog	No watchdog	BTM9021EP has a watchdog

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2.3 How can I improve the accuracy of the current sense?

The accuracy of current sense depends on the offset of the current sense output, production spread, temperature, and the age of the device.

There is an offset current I_{OS} at the current sense output, as shown in the figure below. In this case, $I_{IS} = I_{OS} + I_{Load} / Kilis$. So, $Kilis = I_{Load} / (I_{IS} - I_{OS})$. Using the simple calculation $Kilis = I_{Load} / I_{IS}$ leads to inaccuracy.

To eliminate the impact of the production spread and offset the current on the results, we recommend end-of-line calibration with a differential method:

1. Before the normal operation of the device:
 - a. Drive a load with a correct configuration: measure the load current I_{L1} and measure the load current at IS output I_{IS1}
 - b. Drive a load with a correct configuration: measure the load current I_{L2} and measure the load current at IS output I_{IS2}
 - c. Calculate the real Kilis: $Kilis = (I_{L2} - I_{L1}) / (I_{IS2} - I_{IS1})$
 - d. Calculate the offset current: $I_{OS} = I_{IS1} - I_{L1} / Kilis = I_{IS2} - I_{L2} / Kilis$
 - e. Store the Kilis and I_{OS} in the microcontroller
2. In normal operation: Calculate the load current with the results above: $I_L = (I_{IS} - I_{OS}) * Kilis$

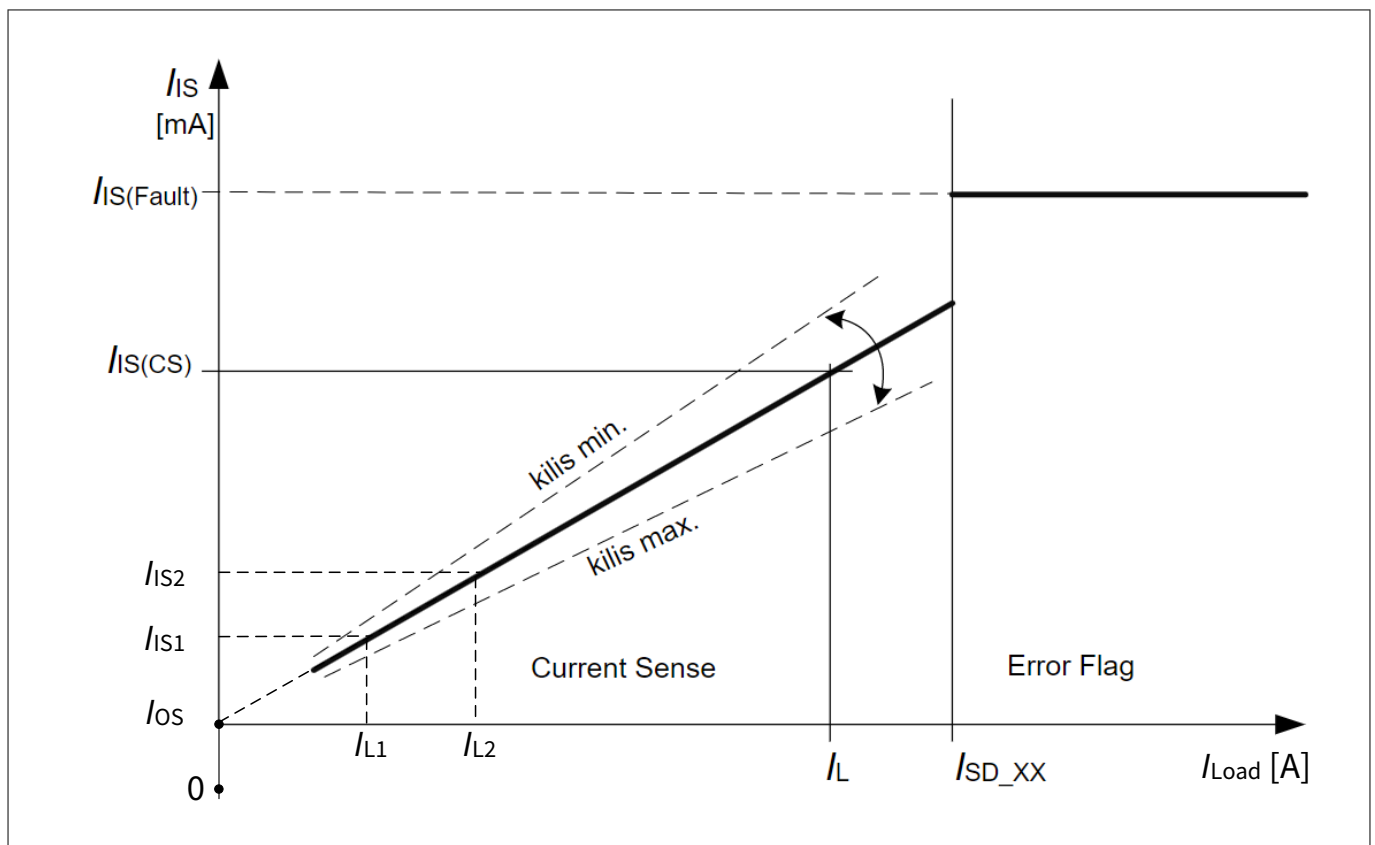


Figure 2 BTM90xx end-of-line calibration with differential method

Kilis drifts from the nominal value when the temperature changes. Adapting the Kilis value based on temperature improves the accuracy. In this case, consider placing a temperature sensor close to the device.

2.4 Can BTM90xxEP devices be used in a 24 V system?

24 V is not covered by the functional range but covered in the extended range. In this case, the device functions, but the behavior can deviate from the specification in the datasheet.

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We recommend additional testing and verification when the BTM90xxEP is implemented in a 24 V system.

2.5 Can the fault and slew rate of BTM90x1EP be monitored via the IS pin?

BTM90x1EP devices can present a fault at the IS pin, global error flag, and status register. But the update of the slew rate cannot be observed at the IS pin. Check the SR bit in the control register to check the slew rate.

2.6 Why does the device not respond to the SPI input when the device is in standby mode?

When the device is in standby mode, as defined in datasheet chapter 8.5, the [serial clock \(SCLK\)](#) signal must be LOW for minimum t_{BEF} before the CS pin's rising edge and t_{wakeup} after the CS pin's rising edge. If the timing of SCLK does not follow the guidance, the device does not respond to the [SPI](#) input.

2.7 How does the open load diagnosis work?

The open load diagnosis is an on-state diagnosis. It is recommended that you do an open load diagnosis before turning on the switches to drive external loads.

During the diagnosis, the load current is internally connected to a grounded resistor inside the device to generate a voltage. A comparator compares the generated voltage with a threshold voltage. If the generated voltage is lower than the threshold, an open load is detected. The device reports an open load error if the open load still present after the open load filter time t_{D_OL} .

If off-state diagnosis is required, consider designing external circuitry.

2.8 How should I handle unused pins?

When pins are not used, refer to the guidance below:

- OUTx pins: Leave open
- IS pin: Connect to [ground \(GND\)](#) with a pull-down resistor, for example 1 k Ω

2.9 How many BTM90xxEP devices can be connected in a daisy-chained SPI system at the same time?

The number of devices that can be connected in daisy-chained system is limited by the maximum current VDD supply is able to deliver. The more devices connected, the longer delay.

2.10 How do I interpret the open load detection filter time?

When the device has an open-load issue, the device does not report the error immediately. If the error is still present after the open load detection filter time t_{D_OL} , the error is reported on the IS pin output (and in the status register in BTM90x1 devices). If the error disappears within t_{D_OL} , the error is not reported. t_{D_OL} is minimum 5 μ s, as defined in the datasheet.

Glossary

DC

direct current (DC)

One-directional flow of electric charge. An electrochemical cell is a prime example of DC power. Direct current may flow through a conductor such as a wire, but can also flow through semiconductors, insulators, or even through a vacuum as in electron or ion beams. The electric current flows in a constant direction, distinguishing it from alternating current (AC).

FW

freewheeling (FW)

GND

ground (GND)

IC

integrated circuit (IC)

A miniature electronic circuit built on the surface of a thin substrate of a semiconductor material.

PWM

pulse-width modulation (PWM)

A technique to encode an analog value into the duty cycle of a pulsing signal with arbitrary amplitude.

SCLK

serial clock (SCLK)

A signal that is used in synchronous serial communication protocols, to synchronize the transfer of data between devices.

SPI

serial peripheral interface (SPI)

A synchronous serial communication interface specification used for inter-chip communication, primarily in embedded systems.

Revision history

Document version	Date of release	Description of changes
Rev. 1.01	2026-03-23	Chapter 2.3: corrected equations for offset current and load current calculation
Rev. 1.00	2024-08-05	Initial document release

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