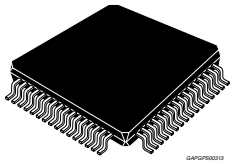
# L9369

# Automotive IC for a specific application of electric parking braking

**Data brief**



**LQFP64 (10x10x1.4mm)**

## Features

- AEC-Q100 qualified
- Functional safety concept for ISO26262 compliance
- 4 High-side and Low-side gate pre-drivers for 8 external power NFETs
- Overcurrent protection with programmable thresholds
- Programmable and NFET independent thresholds for VDS monitoring
- 10 integrated Fully differential amplifiers with low offset, very precise gain, and self-test
- 10 separate ADC channels for digital processing of motor current and voltage measurement
- 32-bits - 10 MHz SPI with CRC for internal setting, self-test and diagnostics
- Full drive of external power NFETs down to 5.5 V battery input voltage
- Monitoring on Main power supply and continuous BIST for internal regulators
- Double Bandgap reference
- 4 General Purpose I/O stages (GPIO)
- Button Interface (9 configurable I/O pins) for monitoring and diagnostics in Normal and Sleep Mode.
- 2 Motor Speed Sensors (MSS) interfaces to acquire speed information feedbacks via external Hall sensors.
- System wake-up in Sleep Mode
- Watchdog (configurable via SPI)

## Description

The L9369 targets the specific application of electric parking braking, suitable for system configuration in cable-puller or Motor Gear Unit (MGU).

The cores are two H-bridge driver stages to drive 8 external FETs for the rear wheels brakes actuators. The stages are fully driven and configurable via SPI, also in PWM control mode and protected against overcurrent, with drain-source and gate-source voltages monitoring.

A synchronized motor voltages and currents acquisition, is performed via full differential amplifiers with programmable and precise gain and low offset and 10 ADC sigma-delta modulators.

Two configurable HS/LS stages are present with programmable output voltage to drive LED arrays, with feedforward regulation.

2 Motor Speed Sensor interfaces (MSS) are available to acquire position feedback from brake actuators (shared with Lamp driver stage and GPIO).

The set of the interfaces is completed by 4 GPIO (General Purpose I/O) pins and a button interface allows to manage specific customer requirements from Electronic parking braking (EPB) button console both in Normal and Sleep Mode.

**Table 1. Device summary**

| Order code | Package | Packing |
|---|---|---|
| L9369-TR | LQFP64 | Tape & Reel |

# Contents

# 1 Block diagram and pin description

**Figure 1. Simplified block diagram**

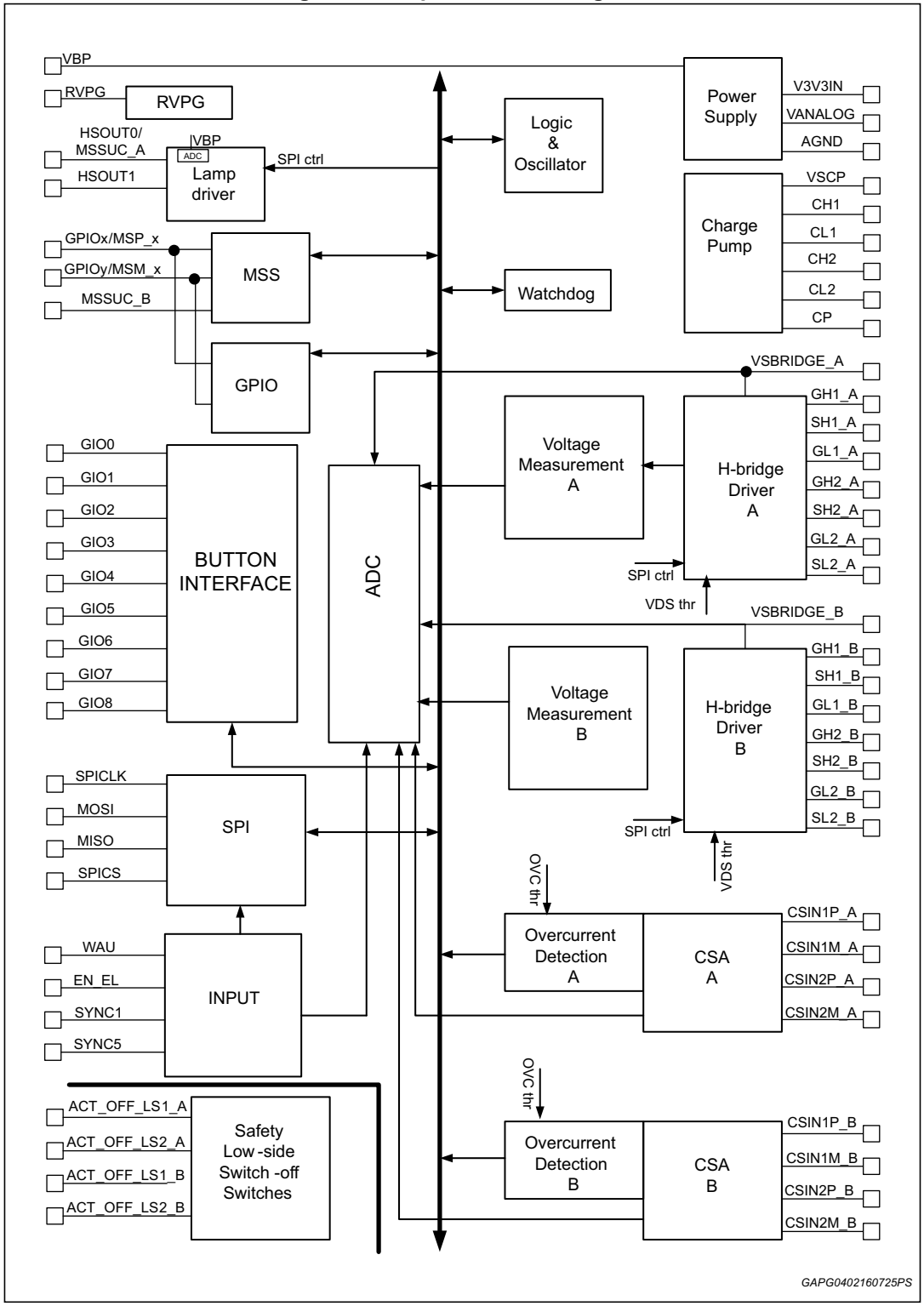
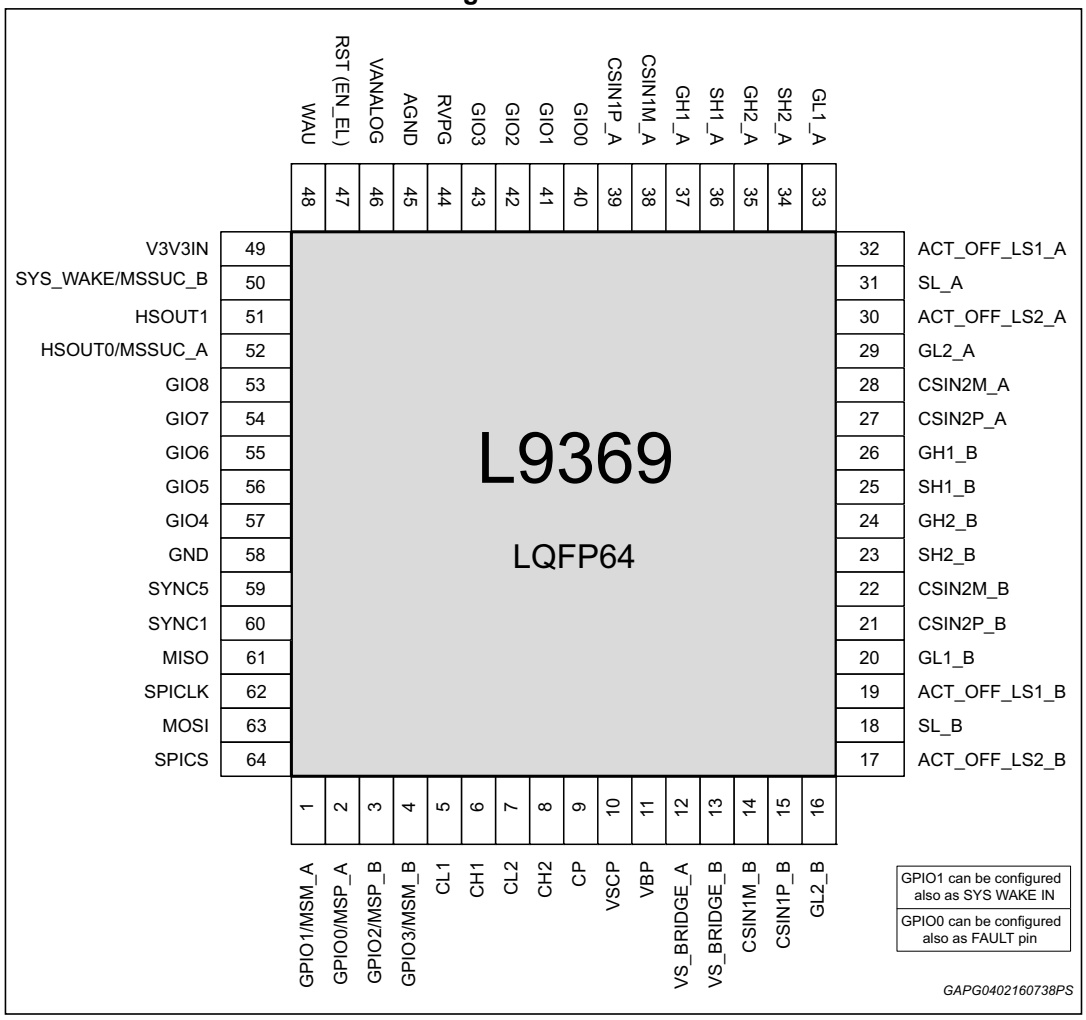


**Figure 2. Pin out**




PIN-out definition and related functions are described in the following *Table 2*.

**Table 2. Pin definition and brief function description**

| Pin # | Symbol | Function | I/O type |
|---|---|---|---|
| 1 | SYS_WAKE_IN / (GPIO1) / (MSM_A) | **SYS_WAKE_IN** is a GPIO (General Purpose Programmable input/output) configured by **default** as digital input for system wake-up trigger in Sleep mode only. Configuration is stored in PROM. *(This function needs the **SYS_WAKE** as companion function to work properly, as SYS_WAKE_IN (feedback from ext network) is managed by logic to provide wake-up output pulse to System basis chip (SBC) during sleep mode (WAU=low). MSM_A is disabled due to pin sharing with GPIO block).*<br><br>***GPIO1*** = General Purpose Programmable input/output pin. After the 1st start-up **SYS_WAKE_IN** can be disabled via SPI in case not requested by application.<br>***MSM_A*** = Return pin for the motor speed sensor of stage A with monitoring and short-circuit protection. (**SYS_WAKE_IN** and GPIO1 functionalities are disabled) | I/O |
| 2 | GPIO0 / MSP_A (FAULT PIN) | **GPIO0** = General Purpose Programmable input/output pin<br>**MSP_A** = Supply pin for the motor speed sensor of stage A with monitoring short to GND protection and reverse supply protection<br>(*GPIO0 can be configured as Fault pin with programmable fault set via SPI and storage in PROM).* | I/O |
| 3 | GPIO2/MSP_B | **GPIO2** = General Purpose Programmable input/output pin<br>**MSP_B** = Supply pin for the motor speed sensor of stage B with monitoring short to GND protection and reverse supply protection | I/O |
| 4 | GPIO3/MSM_B | **GPIO3** = General Purpose Programmable input/output pin<br>**MSM_B** = Return pin for the motor speed sensor of stage B with monitoring and short-circuit protection | I/O |
| 5 | CL1 | Low connection of the stage 1 external pump capacitor | I |
| 6 | CH1 | High connection of the stage 1external pump capacitor | I |
| 7 | CL2 | Low connection of the stage 2 external pump capacitor | I |
| 8 | CH2 | High connection of the stage 2 external pump capacitor | I |
| 9 | CP | Charge pump output voltage | O |
| 10 | VSCP | Charge pump supply voltage with monitoring | I |
| 11 | VBP | Battery supply and redundant supply for charge pump stage.*(Due to PROM data loss, configuration is lost if VBP<VBPpermanent)* | I |
| 12 | VSBRIDGE_A | Drain connection of the external H-Bridge High-side NFET and measurement input for H-bridge supply voltage (stage A) | I |
| 13 | VSBRIDGE_B | Drain connection of the external H-Bridge High-side NFET and measurement input for H-bridge supply voltage (stage B) | I |
| 14 | CSIN1M_B | Negative input pin of the external shunt #1 connected to CSA stage B | I |

**Table 2. Pin definition and brief function description (continued)**

| Pin # | Symbol | Function | I/O type |
|---|---|---|---|
| 15 | CSIN1P_B | Positive input pin of the external shunt #1 connected to CSA stage B | I |
| 16 | GL2_B | Gate connection of the H-Bridge Low-side NFET for wheel brake actuator B | O |
| 17 | ACT_OFF_LS2_B | Safety LS switch-off switches for H-bridge stage B | I |
| 18 | SL_B | Source connection of the H-Bridge Low-side switches for wheel brake actuator B | I |
| 19 | ACT_OFF_LS1_B | Safety LS switch-off switches for stage H-bridge B | I |
| 20 | GL1_B | Gate connection of the H-Bridge Low-side NFET for right wheel brake actuator B | I |
| 21 | CSIN2P_B | Positive input signal of the external shunt #2 connected to redundant CSA for stage B | I |
| 22 | CSIN2M_B | Negative input signal of the external shunt #2 connected to redundant CSA for stage B | I |
| 23 | SH2_B | Source connection of the H-Bridge High-side NFET for wheel brake actuator B | I |
| 24 | GH2_B | Gate connection of the H-Bridge High-side NFET for wheel brake actuator B | O |
| 25 | SH1_B | Source connection of the H-Bridge High-side NFET for wheel brake actuator B | I |
| 26 | GH1_B | Gate connection of the H-Bridge High-side NFET for wheel brake actuator B | O |
| 27 | CSIN2P_A | Positive input signal of the external shunt #2 connected to redundant CSA stage for A | I |
| 28 | CSIN2M_A | Negative input signal of the external shunt #2 connected to redundant CSA for stage A | I |
| 29 | GL2_A | Gate connection of the H-Bridge Low-side NFET for wheel brake actuator A | O |
| 30 | ACT_OFF_LS2_A | Safety LS switch-off switch for stage H-bridge A | I |
| 31 | SL_A | Source connection of the H-Bridge Low-side switches for wheel brake actuator A | I |
| 32 | ACT_OFF_LS1_A | Safety LS switch-off switch for stage H-bridge A | I |
| 33 | GL1_A | Gate connection of the H-Bridge Low-side NFET for wheel brake actuator A | O |
| 34 | SH2_A | Source connection of the H-Bridge High-side NFET for wheel brake actuator A | I |
| 35 | GH2_A | Gate connection of the H-Bridge High-side NFET for wheel brake actuator A | O |
| 36 | SH1_A | Source connection of the H-Bridge High-side NFET for wheel brake actuator A | I |

**Table 2. Pin definition and brief function description (continued)**

| Pin # | Symbol | Function | I/O type |
|---|---|---|---|
| 37 | GH1_A | Gate connection of the H-Bridge High-side NFET for wheel brake actuator A | O |
| 38 | CSIN1M_A | Negative input signal of the external shunt #1 connected to CSA for stage A | I |
| 39 | CSIN1P_A | Positive input signal of the external shunt #1 connected to CSA for stage A | I |
| 40 | GIO0 | Programmable Input / Output for Button Interface control | I/O |
| 41 | GIO1 | Programmable Input / Output for Button Interface control | I/O |
| 42 | GIO2 | Programmable Input / Output for Button Interface control | I/O |
| 43 | GIO3 | Programmable Input / Output for Button Interface control | I/O |
| 44 | RVPG | Gate driver output for reverse voltage switch control | O |
| 45 | AGND | Analog reference ground connection | GND |
| 46 | VANALOG | L9369 generated Low noise analog voltage, supplies the internal current measurement path. *(It can be used to supply external circuits with low current consumption. External capacitor required for stabilization.)* | O |
| 47 | RST (EN_EL) | ***EN_EL***: digital enable input for GPIO (default pin function).<br>***RST***: High active Input Reset pin. *(Enabled via dedicated SPI bit. GPIO block can be enabled and configured independently)* | I |
| 48 | WAU | Wake-up input. (*digital input*, *low level active to enter Sleep Mode*) | I |
| 49 | V3V3VIN | 3.3 V supply voltage for L9369 output buffers | I |
| 50 | SYS_WAKE/MSSUC_B | ***SYS WAKE*** (default configuration at start-up) is a digital output pin to wake System basis chip (SBC) up as support for general diagnostics on the external button during Sleep Mode only. This function/pin needs the ***SYS_WAKE_IN*** as companion function to work properly. MSSUC_B is disabled due to pin sharing with GPIO block.<br>In case the ***SYS_WAKE*** function is not requested by application, It can be disabled via SPI at 1st start-up and the pin can be configured as:<br>***MSSUC_B*** = Motor speed sensor signal output to the µC. *(MSS interface is disabled by default and its functionality is shared with Lamp driver HSOUT).* | O |
| 51 | HSOUT1 | HSOUT1 = SPI programmable HS/LS current source for external bulb lamp or LED array with monitoring | O |
| 52 | HSOUT0/MSSUC_A | **HSOUT0** = SPI programmable HS/LS current source for external bulb lamp or LED array with monitoring<br>**MSSUC_A** = Motor speed sensor signal output to the µC. *MSS interface is disabled by default.* | O |
| 53 | GIO8 | Programmable Input / Output for Button Interface control | I/O |

**Table 2. Pin definition and brief function description (continued)**

| Pin # | Symbol | Function | I/O type |
|---|---|---|---|
| 54 | GIO7 | Programmable Input / Output for Button Interface control | I/O |
| 55 | GIO6 | Programmable Input / Output for Button Interface control | I/O |
| 56 | GIO5 | Programmable Input / Output for Button Interface control | I/O |
| 57 | GIO4 | Programmable Input / Output for Button Interface control | I/O |
| 58 | GND | Digital and power ground connection | GND |
| 59 | SYNC5 | Synchronization signal from µC for ADC voltage/current measurement path | I |
| 60 | SYNC1 | Synchronization signal from µC for ADC voltage/current measurement path | I |
| 61 | MISO | Serial data out for SPI communication to µC | O |
| 62 | SPICLK | Clock signal for SPI | I |
| 63 | MOSI | Serial data input for SPI communication from µC | I |
| 64 | SPICS | Chip select for SPI | I |

**Table 3. General conditions**

| Symbol | Parameter | Test conditions | Min | Typ | Max | Unit | Parameter ID |
|---|---|---|---|---|---|---|---|
| $T_{junction}$ | Function temperature | (parameters guaranteed) | -40 | - | 175 | °C | L9369_194 |
| $R_{th}$ | Application specific $R_{th}$ | (Housing mounted on 6-Layer PCB) | - | - | 40 | °C/W | L9369_3052 |

# 2 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: *www.st.com*. ECOPACK® is an ST trademark.

## 2.1 LQFP64 (10x10x1.4 mm) package information

**Figure 3. LQFP64 (10x10x1.4 mm) package outline**

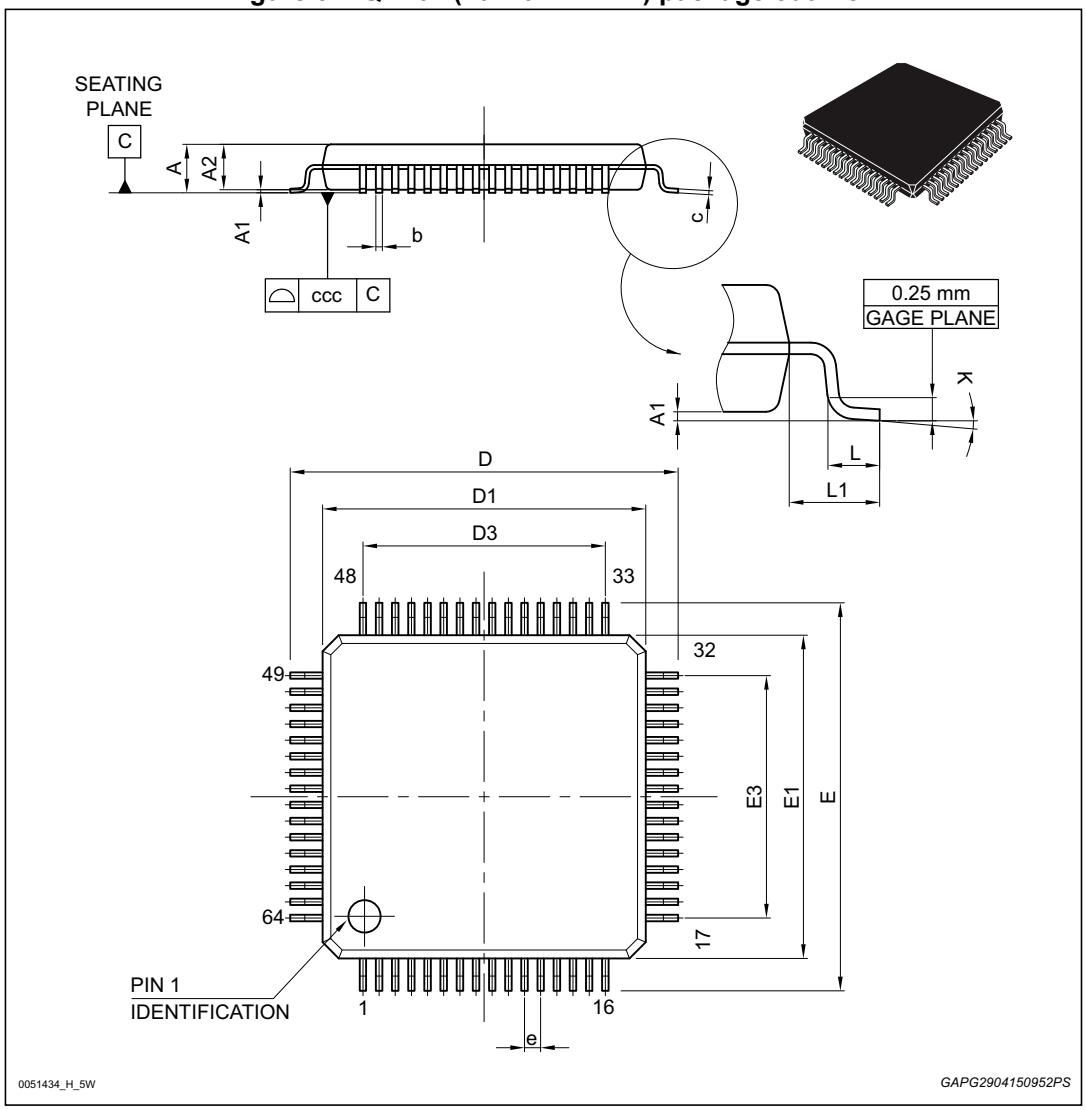


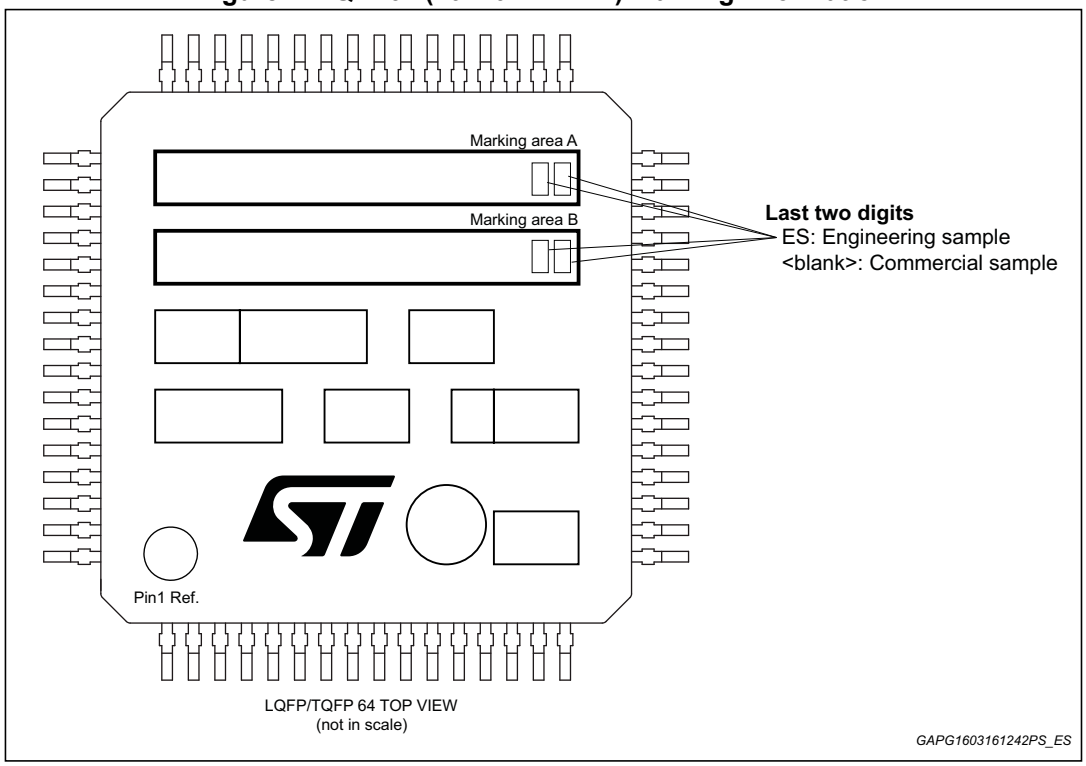
**Table 4. LQFP64 (10x10x1.4 mm) package mechanical data**

| Ref | Dimensions | | | | | |
|---|---|---|---|---|---|---|
| | Millimeters | | | Inches[1] | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | - | - | 1.60 | - | - | 0.0630 |
| A1 | 0.05 | - | 0.15 | 0.0020 | - | 0.0059 |
| A2 | 1.350 | 1.40 | 1.45 | 0.0531 | 0.0551 | 0.0571 |
| b | 0.17 | 0.22 | 0.27 | 0.0067 | 0.0087 | 0.0106 |
| c | 0.09 | - | 0.20 | 0.0035 | - | 0.0079 |
| D | 11.80 | 12.00 | 12.20 | 0.4646 | 0.4724 | 0.4803 |
| D1 | 9.80 | 10.00 | 10.20 | 0.3858 | 0.3937 | 0.4016 |
| D3 | - | 7.50 | - | - | 0.2953 | - |
| E | 11.80 | 12.00 | 12.20 | 0.4646 | 0.4724 | 0.4803 |
| E1 | 9.80 | 10.00 | 10.20 | 0.3858 | 0.3937 | 0.4016 |
| E3 | - | 7.50 | - | - | 0.2953 | - |
| e | - | 0.50 | - | - | 0.0197 | - |
| L | 0.45 | 0.60 | 0.75 | 0.0177 | 0.0236 | 0.0295 |
| L1 | - | 1.00 | - | - | 0.0394 | - |
| K | 0° (min.), 3.5° (typ.) 7° (max.) | | | | | |
| ccc | - | - | 0.08 | - | - | 0.0031 |

1. Values in inches are converted from mm and rounded to 4 decimal digits.

## 2.2 LQFP64 (10x10x1.4 mm) marking information

**Figure 4. LQFP64 (10x10x1.4 mm) marking information**




Parts marked as ‘ES’ are not yet qualified and therefore not approved for use in production. ST is not responsible for any consequences resulting from such use. In no event ST is liable for the customer using any of these engineering samples in production. ST’s Quality department must be contacted to run a qualification activity prior to any decision to use these engineering samples.

# 3 Revision history

Table 5. Document revision history

| Date | Revision | Changes |
|---|---|---|
| 11-Jan-2019 | 1 | Initial release. |