

Gas Gauge IC With SMBus Interface

Features

- ▶ 0.1% accuracy
- ▶ Wide operating temperature range: -40°C to 125°C
- ▶ Programmable alarm
- ▶ Low power consumption: $I_{CC} < 1 \mu\text{A}$
- ▶ Programmable current limit
 - Programmable current limit
 - Programmable current limit
 - Programmable current limit
- ▶ Programmable current limit
- ▶ Programmable current limit
- ▶ Programmable current limit
- ▶ Programmable current limit

General Description

The bq2040 is a gas gauge IC with SMBus interface. It provides accurate measurement of battery capacity and status. The device is designed for use in portable electronic devices. It features a programmable current limit, a programmable alarm, and a low power consumption. The device is available in a 16-pin narrow SOIC package.

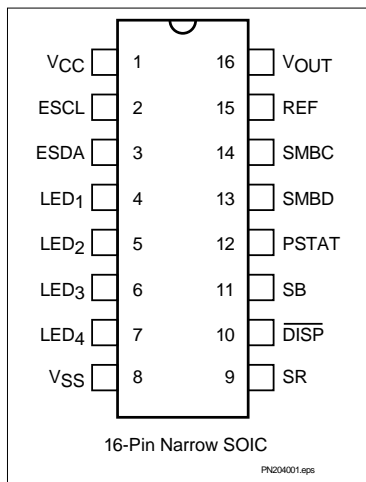
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Pin Connections



Pin Names

V _{CC}	3.0–6.5V	SB	Battery sense input
ESCL	EEPROM clock	PSTAT	Protector status input
ESDA	EEPROM data	SMBD	SMBus data input/output
LED ₁₋₄	LED segment 1-4	SMBC	SMBus clock
V _{SS}	System ground	REF	Voltage reference output
SR	Sense resistor input	V _{OUT}	EEPROM supply output
$\overline{\text{DISP}}$	Display control input		

bq2040

Pin Descriptions

VCC **Supply voltage input**

ESCL **Serial memory clock**

ESDA **Serial memory data and address**

LED1-LED4 **LED display segment outputs**

VSS **Ground**

SR **Sense resistor input**

DISP **Display control input**

SB **Secondary battery input**

PSTAT **Protector status input**

SMBD **SMBus data**

SMBC **SMBus clock**

REF **Reference output for regulator**

VOUT **Supply output**

bq2040

Description

TP6

TP6 >—

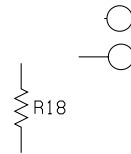
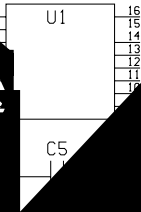


Table 1. Configuration Memory Map (Continued)

Parameter Name	Address	Description	Length	Units
Δ_{Voc}	Δ_{Voc}	Open-circuit voltage error	1	▶
$\Delta_{\text{Voc}}^{\text{max}}$	$\Delta_{\text{Voc}}^{\text{max}}$	Maximum open-circuit voltage error	1	▶
$\Delta_{\text{Voc}}^{\text{min}}$	$\Delta_{\text{Voc}}^{\text{min}}$	Minimum open-circuit voltage error	1	▶
$\Delta_{\text{Voc}}^{\text{avg}}$	$\Delta_{\text{Voc}}^{\text{avg}}$	Average open-circuit voltage error	1	▶
$\Delta_{\text{Voc}}^{\text{std}}$	$\Delta_{\text{Voc}}^{\text{std}}$	Standard deviation of open-circuit voltage error	1	▶
$\Delta_{\text{Voc}}^{\text{var}}$	$\Delta_{\text{Voc}}^{\text{var}}$	Variance of open-circuit voltage error	1	▶
$\Delta_{\text{Voc}}^{\text{cov}}$	$\Delta_{\text{Voc}}^{\text{cov}}$	Covariance of open-circuit voltage error	1	▶
$\Delta_{\text{Voc}}^{\text{corr}}$	$\Delta_{\text{Voc}}^{\text{corr}}$	Corrected open-circuit voltage error	1	▶
$\Delta_{\text{Voc}}^{\text{corr}}^{\text{max}}$	$\Delta_{\text{Voc}}^{\text{corr}}^{\text{max}}$	Maximum corrected open-circuit voltage error	1	▶
$\Delta_{\text{Voc}}^{\text{corr}}^{\text{min}}$	$\Delta_{\text{Voc}}^{\text{corr}}^{\text{min}}$	Minimum corrected open-circuit voltage error	1	▶
$\Delta_{\text{Voc}}^{\text{corr}}^{\text{avg}}$	$\Delta_{\text{Voc}}^{\text{corr}}^{\text{avg}}$	Average corrected open-circuit voltage error	1	▶
$\Delta_{\text{Voc}}^{\text{corr}}^{\text{std}}$	$\Delta_{\text{Voc}}^{\text{corr}}^{\text{std}}$	Standard deviation of corrected open-circuit voltage error	1	▶
$\Delta_{\text{Voc}}^{\text{corr}}^{\text{var}}$	$\Delta_{\text{Voc}}^{\text{corr}}^{\text{var}}$	Variance of corrected open-circuit voltage error	1	▶
$\Delta_{\text{Voc}}^{\text{corr}}^{\text{cov}}$	$\Delta_{\text{Voc}}^{\text{corr}}^{\text{cov}}$	Covariance of corrected open-circuit voltage error	1	▶
$\Delta_{\text{Voc}}^{\text{corr}}^{\text{corr}}$	$\Delta_{\text{Voc}}^{\text{corr}}^{\text{corr}}$	Corrected corrected open-circuit voltage error	1	▶
$\Delta_{\text{Voc}}^{\text{corr}}^{\text{corr}}^{\text{max}}$	$\Delta_{\text{Voc}}^{\text{corr}}^{\text{corr}}^{\text{max}}$	Maximum corrected corrected open-circuit voltage error	1	▶
$\Delta_{\text{Voc}}^{\text{corr}}^{\text{corr}}^{\text{min}}$	$\Delta_{\text{Voc}}^{\text{corr}}^{\text{corr}}^{\text{min}}$	Minimum corrected corrected open-circuit voltage error	1	▶
$\Delta_{\text{Voc}}^{\text{corr}}^{\text{corr}}^{\text{avg}}$	$\Delta_{\text{Voc}}^{\text{corr}}^{\text{corr}}^{\text{avg}}$	Average corrected corrected open-circuit voltage error	1	▶
$\Delta_{\text{Voc}}^{\text{corr}}^{\text{corr}}^{\text{std}}$	$\Delta_{\text{Voc}}^{\text{corr}}^{\text{corr}}^{\text{std}}$	Standard deviation of corrected corrected open-circuit voltage error	1	▶
$\Delta_{\text{Voc}}^{\text{corr}}^{\text{corr}}^{\text{var}}$	$\Delta_{\text{Voc}}^{\text{corr}}^{\text{corr}}^{\text{var}}$	Variance of corrected corrected open-circuit voltage error	1	▶
$\Delta_{\text{Voc}}^{\text{corr}}^{\text{corr}}^{\text{cov}}$	$\Delta_{\text{Voc}}^{\text{corr}}^{\text{corr}}^{\text{cov}}$	Covariance of corrected corrected open-circuit voltage error	1	▶

Voltage Thresholds

4. The voltage threshold is the voltage level at which the output of the neuron is set to 1. This is a binary value, so the output is either 0 or 1. The voltage threshold is a parameter that can be adjusted to control the sensitivity of the neuron. A higher voltage threshold means the neuron is less sensitive to input, while a lower voltage threshold means the neuron is more sensitive to input.

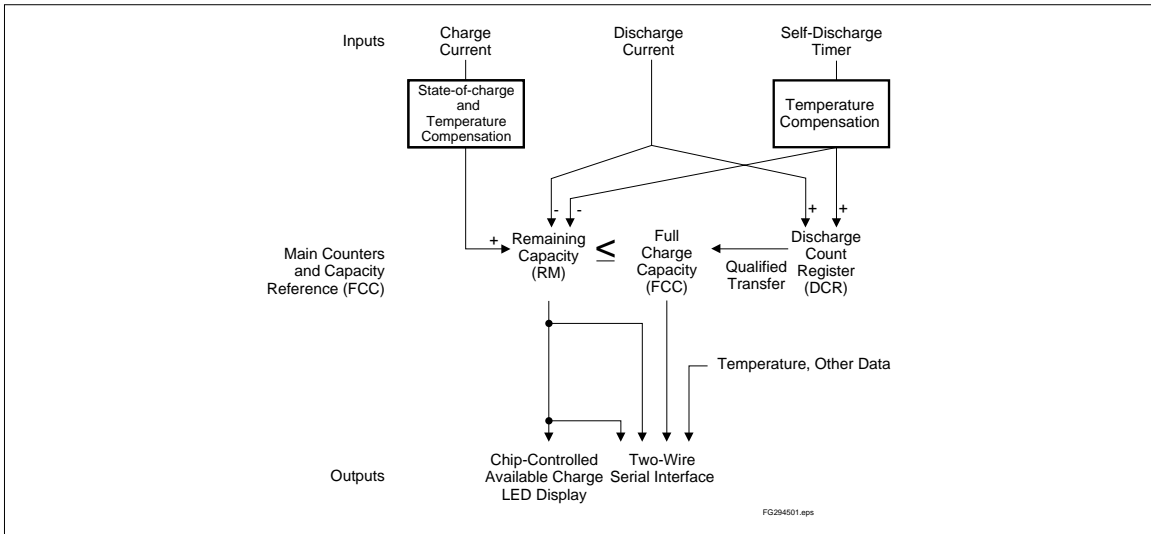


Figure 2. Operational Overview

1. **DesignCapacity (DC):**
 The Design Capacity (DC) is the total capacity of the battery, expressed in units of Design Capacity (DC). It is a constant value that represents the maximum amount of charge that the battery can store. The DC is determined by the battery's chemistry and construction.

2. **DesignCapacity (DC):**

The Design Capacity (DC) is the total capacity of the battery, expressed in units of Design Capacity (DC). It is a constant value that represents the maximum amount of charge that the battery can store. The DC is determined by the battery's chemistry and construction.

3. **RemainingCapacity (RM):**

The Remaining Capacity (RM) is the amount of charge that is currently stored in the battery, expressed in units of Design Capacity (DC). It is a variable value that changes as the battery is used or recharged. The RM is determined by the battery's current state of charge and the amount of charge that has been used.

4. **Discharge Count Register (DCR):**

The Discharge Count Register (DCR) is a register that stores the number of times the battery has been discharged. It is a variable value that increases each time the battery is discharged. The DCR is used to track the battery's usage and to determine when the battery needs to be recharged.

The DCR is a 16-bit register that is located in the bq2040 chip. It is used to track the number of times the battery has been discharged. The DCR is updated each time the battery is discharged, and its value is stored in the DCR register.

- The DCR is updated each time the battery is discharged, and its value is stored in the DCR register.
- The DCR is a 16-bit register that is located in the bq2040 chip.
- The DCR is used to track the number of times the battery has been discharged.
- The DCR is updated each time the battery is discharged, and its value is stored in the DCR register.

Charge Counting

• The total charge of a system is conserved. The total charge of a system is conserved. The total charge of a system is conserved.

• The total charge of a system is conserved. The total charge of a system is conserved. The total charge of a system is conserved. **A valid**

Charge Suspension

2040 1

■ **Maximum Overcharge:** EE 03 03 M=FCC,

■ **Overvoltage:** A 2040 1 5% 2040 105% C 2561 A

■ **Overcurrent:** A 2040 1 25% 1024 A 2561 A 2040 2561 A

■ **Maximum Temperature:** 48 C -5°C

■ **PSTAT:** P A ≥1.5 0 <1.0

■ **Low Temperature:** 12 C (L F FLAG 2), 15°C,

■ **Undervoltage:** ED F ED F EE0 5 /0 5 O L F

Count Compensations

C M DC

Charge Compensation

1.) $M = M * (L_{EFC} - -E)$

$\alpha C < F \alpha C P$

0.75 1.0.

2.) $M = M * (L_{EC} - -E)$

$\alpha C \geq F \alpha C P$

0.75 1.0.

-E = 0 < 30°C

-E = 0.02 30°C ≤ < 40°C

-E = 0.05 ≥ 40°C

-E 0 L-I

Digital Magnitude Filter

2040

$$DMF = \frac{45}{D}$$

Table 2. Typical Digital Filter Settings

DMF	DMF Hex.	V _{SRD} (mV)
75	4B	0.60
100	64	0.45
150	96	0.30
175	AF	0.26
200	C8	0.23

Error Summary

Capacity Inaccurate

Capacity Inaccurate: The battery capacity is not accurate. This is caused by the battery's internal resistance (IR) and the battery's self-discharge rate. The battery's capacity is measured at a specific current and voltage, and the capacity is not constant. The capacity is affected by the battery's temperature, the battery's age, and the battery's usage. The capacity is also affected by the battery's internal resistance (IR) and the battery's self-discharge rate. The capacity is measured at a specific current and voltage, and the capacity is not constant. The capacity is affected by the battery's temperature, the battery's age, and the battery's usage.

Current-Sensing Error

Current-Sensing Error: The current sensing is not accurate. This is caused by the current sensor's internal resistance and the current sensor's self-discharge rate. The current sensing is measured at a specific current and voltage, and the current sensing is not constant. The current sensing is affected by the current sensor's temperature, the current sensor's age, and the current sensor's usage.

Display

Display: The display is not accurate. This is caused by the display's internal resistance and the display's self-discharge rate. The display is measured at a specific current and voltage, and the display is not constant. The display is affected by the display's temperature, the display's age, and the display's usage.

4. The battery's capacity is not accurate. This is caused by the battery's internal resistance (IR) and the battery's self-discharge rate. The battery's capacity is measured at a specific current and voltage, and the capacity is not constant. The capacity is affected by the battery's temperature, the battery's age, and the battery's usage.

5. The current sensing is not accurate. This is caused by the current sensor's internal resistance and the current sensor's self-discharge rate. The current sensing is measured at a specific current and voltage, and the current sensing is not constant. The current sensing is affected by the current sensor's temperature, the current sensor's age, and the current sensor's usage.

6. The display is not accurate. This is caused by the display's internal resistance and the display's self-discharge rate. The display is measured at a specific current and voltage, and the display is not constant. The display is affected by the display's temperature, the display's age, and the display's usage.

■ 4.2.2.3

4.2.2.3.1 Host-to-bq2040 Messages (see Table 4)

Host-to-bq2040 Messages (see Table 4)

ManufacturerAccess() (0x00)

4.2.2.3.1.1 ManufacturerAccess() (0x00)

RemainingCapacityAlarm() (0x01)

4.2.2.3.1.2 RemainingCapacityAlarm() (0x01)

4.2.2.3.1.3 RemainingTimeAlarm() (0x02)

RemainingTimeAlarm() (0x02)

4.2.2.3.1.4 RemainingTimeAlarm() (0x02)

4.2.2.3.2 BatteryMode() (0x03)

BatteryMode() (0x03)

4.2.2.3.2.1 BatteryMode() (0x03)

4.2.2.3.2.2 BatteryMode() (0x03)

4.2.2.3.2.3 BatteryMode() (0x03)

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Table 4. bq2040 Register Functions

Function	Code	Access	Units	Defaults ¹
0x00	0x00	R/W	-	-
0x01	0x01	R/W	bits	0x00
0x02	0x02	R/W	bits	0x00
0x03	0x03	R/W	bits	0x00
0x04	0x04	R/W	bits	0x00
0x05	0x05	R/W	bits	0x00
0x06	0x06	R/W	bits	0x00
0x07	0x07	R/W	bits	0x00
0x08	0x08	R/W	bits	0x00
0x09	0x09	R/W	bits	0x00
0x0A	0x0A	R/W	bits	0x00
0x0B	0x0B	R/W	bits	0x00
0x0C	0x0C	R/W	bits	0x00
0x0D	0x0D	R/W	bits	0x00
0x0E	0x0E	R/W	bits	0x00
0x0F	0x0F	R/W	bits	0x00
0x10	0x10	R/W	bits	0x00
0x11	0x11	R/W	bits	0x00
0x12	0x12	R/W	bits	0x00
0x13	0x13	R/W	bits	0x00
0x14	0x14	R/W	bits	0x00
0x15	0x15	R/W	bits	0x00
0x16	0x16	R/W	bits	0x00
0x17	0x17	R/W	bits	0x00
0x18	0x18	R/W	bits	0x00
0x19	0x19	R/W	bits	0x00
0x1A	0x1A	R/W	bits	0x00
0x1B	0x1B	R/W	bits	0x00
0x1C	0x1C	R/W	bits	0x00
0x1D	0x1D	R/W	bits	0x00
0x1E	0x1E	R/W	bits	0x00
0x1F	0x1F	R/W	bits	0x00
0x20	0x20	R/W	bits	0x00
0x21	0x21	R/W	bits	0x00
0x22	0x22	R/W	bits	0x00
0x23	0x23	R/W	bits	0x00
0x24	0x24	R/W	bits	0x00
0x25	0x25	R/W	bits	0x00
0x26	0x26	R/W	bits	0x00
0x27	0x27	R/W	bits	0x00
0x28	0x28	R/W	bits	0x00
0x29	0x29	R/W	bits	0x00
0x2A	0x2A	R/W	bits	0x00
0x2B	0x2B	R/W	bits	0x00
0x2C	0x2C	R/W	bits	0x00
0x2D	0x2D	R/W	bits	0x00
0x2E	0x2E	R/W	bits	0x00
0x2F	0x2F	R/W	bits	0x00
0x30	0x30	R/W	bits	0x00
0x31	0x31	R/W	bits	0x00
0x32	0x32	R/W	bits	0x00
0x33	0x33	R/W	bits	0x00
0x34	0x34	R/W	bits	0x00
0x35	0x35	R/W	bits	0x00
0x36	0x36	R/W	bits	0x00
0x37	0x37	R/W	bits	0x00
0x38	0x38	R/W	bits	0x00
0x39	0x39	R/W	bits	0x00
0x3A	0x3A	R/W	bits	0x00
0x3B	0x3B	R/W	bits	0x00
0x3C	0x3C	R/W	bits	0x00
0x3D	0x3D	R/W	bits	0x00
0x3E	0x3E	R/W	bits	0x00
0x3F	0x3F	R/W	bits	0x00

Note: 1. Defaults are shown in hexadecimal.

bq2040

- **Temperature()** (0x08)
 - ▶ **Temperature** (0x08) (Temperature)
- **Voltage()** (0x09)
 - ▶ **Voltage** (0x09) (Voltage)
- **Current()** (0x0a)
 - ▶ **Current** (0x0a) (Current)
- **AverageCurrent()** (0x0b)
 - ▶ **AverageCurrent** (0x0b) (AverageCurrent)
- **AtRateTimeToFull()** (0x05)
 - ▶ **AtRateTimeToFull** (0x05) (AtRateTimeToFull)
- **AtRateTimeToEmpty()** (0x06)
 - ▶ **AtRateTimeToEmpty** (0x06) (AtRateTimeToEmpty)
- **AtRateOK()** (0x07)
 - ▶ **AtRateOK** (0x07) (AtRateOK)

AtRateTimeToFull() (0x05)

The bq2040 returns the estimated time to full charge at the current rate (▶) in minutes.

Temperature (0x08) (Temperature)

Voltage (0x09)

Current (0x0a)

AverageCurrent (0x0b)

AtRateTimeToFull (0x05) (AtRateTimeToFull)

AtRateTimeToEmpty() (0x06)

The bq2040 returns the estimated time to empty at the current rate (▶) in minutes.

Temperature (0x08) (Temperature)

Voltage (0x09)

Current (0x0a)

AverageCurrent (0x0b)

AtRateTimeToFull (0x05) (AtRateTimeToFull)

AtRateOK() (0x07)

The bq2040 returns the estimated time to full charge at the current rate (▶) in minutes.

Temperature (0x08) (Temperature)

Voltage (0x09)

Current (0x0a) (Current)

Temperature() (0x08)

The bq2040 returns the temperature in Celsius (▶) in degrees Celsius.

Voltage (0x09) (Voltage)

Current (0x0a)

AverageCurrent (0x0b)

AtRateTimeToFull (0x05)

AtRateTimeToEmpty (0x06)

Voltage() (0x09)

The bq2040 returns the battery voltage (▶) in Volts (V).

Temperature (0x08) (Temperature)

Current (0x0a)

AverageCurrent (0x0b)

AtRateTimeToFull (0x05) (AtRateTimeToFull)

AtRateTimeToEmpty (0x06) (AtRateTimeToEmpty)

Current() (0x0a)

The bq2040 returns the current in Amperes (▶) in Amperes (A).

Temperature (0x08) (Temperature)

Voltage (0x09)

AverageCurrent (0x0b)

AtRateTimeToFull (0x05)

AtRateTimeToEmpty (0x06) (AtRateTimeToEmpty)

AtRateOK (0x07) (AtRateOK)

AverageCurrent() (0x0b)

The bq2040 returns the average current in Amperes (▶) in Amperes (A).

Temperature (0x08) (Temperature)

Voltage (0x09)

Current (0x0a) (Current)

AtRateTimeToFull (0x05)

AtRateTimeToEmpty (0x06) (AtRateTimeToEmpty)

▶ \pm %

MaxError() (0x0c)

▶ \pm %

▶ \pm %

▶ \pm %

RelativeStateOfCharge() (0x0d)

▶ \pm %

▶ \pm %

▶ \pm %

▶ \pm %

▶ \pm %

▶ \pm %

AbsoluteStateOfCharge() (0x0e)

▶ \pm %

▶ \pm %

▶ \pm %

▶ \pm %

▶ \pm %

▶ \pm %

RemainingCapacity() (0x0f)

▶ \pm %

▶ \pm %

▶ \pm %

▶ \pm %

▶ \pm %

FullChargeCapacity() (0x10)

▶ \pm %

▶ \pm %

▶ \pm %

▶ \pm %

▶ \pm %

▶ \pm %

RunTimeToEmpty() (0x11)

▶ \pm %

▶ \pm %

▶ \pm %

▶ \pm %

▶ \pm %

AverageTimeToEmpty() (0x12)

▶ \pm %

▶ \pm %

bq2040

The bq2040 provides a digital readout of the average time to full charge for the battery. The average time to full charge is calculated by the bq2040 based on the current and voltage of the battery during charging. The average time to full charge is calculated by the bq2040 based on the current and voltage of the battery during charging.

AverageTimeToFull() (0x13)

The bq2040 provides a digital readout of the average time to full charge for the battery. The average time to full charge is calculated by the bq2040 based on the current and voltage of the battery during charging. The average time to full charge is calculated by the bq2040 based on the current and voltage of the battery during charging.

ChargingCurrent() (0x14)

The bq2040 provides a digital readout of the charging current for the battery. The charging current is the current flowing into the battery during charging. The charging current is the current flowing into the battery during charging.

ChargingVoltage() (0x15)

The bq2040 provides a digital readout of the charging voltage for the battery. The charging voltage is the voltage across the battery during charging. The charging voltage is the voltage across the battery during charging.

BatteryStatus() (0x16)

The bq2040 provides a digital readout of the battery status. The battery status is a 16-bit register that contains information about the battery's state of charge, health, and other parameters. The battery status is a 16-bit register that contains information about the battery's state of charge, health, and other parameters.

Table 5. Status Register

Alarm Bits	
15	Reserved
14	Reserved
13	Reserved
12	Reserved
11	Reserved
10	Reserved
9	Reserved
8	Reserved
7	Reserved
6	Reserved
5	Reserved
4	Reserved
3	Reserved
2	Reserved
1	Reserved
0	Reserved
Status Bits	
15	Reserved
14	Reserved
13	Reserved
12	Reserved
11	Reserved
10	Reserved
9	Reserved
8	Reserved
7	Reserved
6	Reserved
5	Reserved
4	Reserved
3	Reserved
2	Reserved
1	Reserved
0	Reserved
Error Code	
15	Reserved
14	Reserved
13	Reserved
12	Reserved
11	Reserved
10	Reserved
9	Reserved
8	Reserved
7	Reserved
6	Reserved
5	Reserved
4	Reserved
3	Reserved
2	Reserved
1	Reserved
0	Reserved

CycleCount() (0x17)

The bq2040 provides a digital readout of the cycle count for the battery. The cycle count is the number of full charge and discharge cycles that the battery has undergone. The cycle count is the number of full charge and discharge cycles that the battery has undergone.

• `DesignCapacity()` returns the design capacity of the array.
• `DesignCapacity()` returns the design capacity of the array.
• `DesignCapacity()` returns the design capacity of the array.

DesignCapacity() (0x18)

• `DesignCapacity()` returns the design capacity of the array.
• `DesignCapacity()` returns the design capacity of the array.

End of Discharge Voltage1 (0x3e)

0x3e: End of Discharge Voltage1 (0x3e) (V_{OC}), 10-bit, 0.001V/LSB, 0.0001V/LSB

0x3f: End of Discharge VoltageF (0x3f) (V_{OC}), 10-bit, 0.001V/LSB, 0.0001V/LSB

End of Discharge VoltageF (0x3f)

0x3f: End of Discharge VoltageF (0x3f) (V_{OC}), 10-bit, 0.001V/LSB, 0.0001V/LSB

0x40: Flags1&2() (0x2f) (V_{OC}), 10-bit, 0.001V/LSB, 0.0001V/LSB

FLAGS1&2() (0x2f)

0x2f: Flags1&2() (0x2f) (V_{OC}), 10-bit, 0.001V/LSB, 0.0001V/LSB

0x30: Flags1 (0x30) (V_{OC}), 10-bit, 0.001V/LSB, 0.0001V/LSB

FLAGS2

0x31: Display Mode (0x31) (V_{OC}), 10-bit, 0.001V/LSB, 0.0001V/LSB

0x32: (V_{OC}), 10-bit, 0.001V/LSB, 0.0001V/LSB

0x33: (V_{OC}), 10-bit, 0.001V/LSB, 0.0001V/LSB

0x34: (V_{OC}), 10-bit, 0.001V/LSB, 0.0001V/LSB

0x35: (V_{OC}), 10-bit, 0.001V/LSB, 0.0001V/LSB

0x36: (V_{OC}), 10-bit, 0.001V/LSB, 0.0001V/LSB

0x37: (V_{OC}), 10-bit, 0.001V/LSB, 0.0001V/LSB

0x38: (V_{OC}), 10-bit, 0.001V/LSB, 0.0001V/LSB

0x39: (V_{OC}), 10-bit, 0.001V/LSB, 0.0001V/LSB

0x3a: (V_{OC}), 10-bit, 0.001V/LSB, 0.0001V/LSB

0x3b: Chemistry (0x3b) (V_{OC}), 10-bit, 0.001V/LSB, 0.0001V/LSB

→ 2019年12月

→ 2020年1月

→ **Overcurrent** ()

→ 2020年2月

→ 2020年3月

→ 2020年4月

→ 2020年5月

- **First End-of-Discharge Voltage** (V_{ED1}) is the voltage of the battery at the end of the first discharge cycle. It is measured at the end of the discharge cycle when the current is zero.

SBD Seal

The SBD Seal is a type of seal used in the battery to prevent leakage and maintain the internal pressure. It is made of a special material that is resistant to corrosion and has a high melting point.

- **Final End-of-Discharge Voltage** (V_{ED2}) is the voltage of the battery at the end of the final discharge cycle. It is measured at the end of the discharge cycle when the current is zero.

- **Final End-of-Discharge Voltage** (V_{ED2}) is the voltage of the battery at the end of the final discharge cycle. It is measured at the end of the discharge cycle when the current is zero.

Error Codes and Status Bits

- The error codes and status bits are used to monitor the battery's health and detect any faults. They are stored in the battery's memory and can be read by the battery management system.

Table 8. Error Codes (BatteryStatus() (0x16))

Error	Code	Access	Description
OK	0x00	Read/Write	OK
Low Voltage	0x01	Read/Write	Low Voltage
High Voltage	0x02	Read/Write	High Voltage
Temperature Error	0x03	Read/Write	Temperature Error
Charging Error	0x04	Read/Write	Charging Error
Overcurrent Error	0x05	Read/Write	Overcurrent Error
Overtemperature Error	0x06	Read/Write	Overtemperature Error
Undercurrent Error	0x07	Read/Write	Undercurrent Error
Undertemperature Error	0x08	Read/Write	Undertemperature Error

Note: The error codes are returned in the BatteryStatus() register.

Table 10. Example Register Contents (Continued)

Description	EEPROM Address		EEPROM Hex Contents		Example Values	Notes
	Low Byte	High Byte	Low Byte	High Byte		
...
...
...
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...
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...
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...
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Note: ...

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String Description	Address	0x X0	0x X1	0x X2	0x X3	0x X4	0x X5	0x X6	0x X7	0x X8	0x X9	0x Xa	0x Xb
0x00000000	0x00000000	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00
0x00000001	0x00000001	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00
0x00000002	0x00000002	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00
0x00000003	0x00000003	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Absolute Maximum Ratings

Symbol	Parameter	Minimum	Maximum	Unit	Notes
V_{DD}	Supply Voltage	-0.5	+0.5	V	
V_{DD}	Supply Voltage	-0.5	+0.5	V	
V_{DD}	Supply Voltage	-0.5	+0.5	V	(see Figure 1)
V_{DD}	Supply Voltage	-0.5	+0.5	V	Ω (see Figure 1)
V_{DD}	Supply Voltage	-0.5	+0.5	V	

Note: Absolute Maximum Ratings

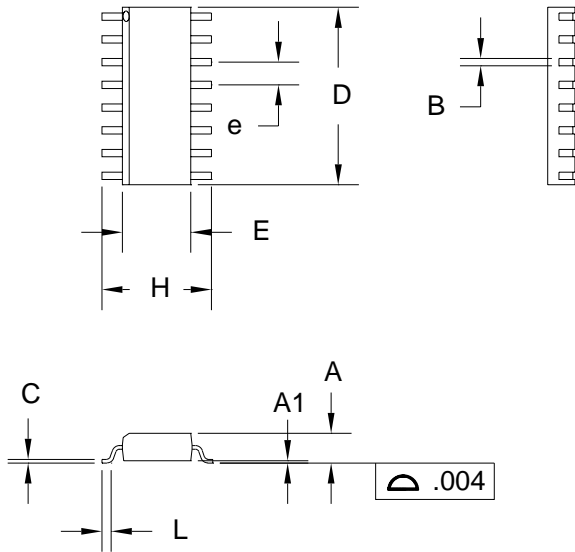
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Recommended DC Operating Conditions (T_A = T_{OPR})

Symbol	Parameter	Minimum	Typical	Maximum	Unit	Notes
V _{CC}	Supply Voltage	0	5.0	5.5	V	V _{CC} must be ≥ V _{CE(sat)} + V _{CE}
V _{CE}	Collector-Emitter Voltage	0	5.0	5.5	V	

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16-Pin SOIC Narrow (SN)



16-Pin SN (SOIC Narrow)

Dimension	Minimum	Maximum
▶	.	..
▶
▶
▶
▶
▶
▶
▶

▶

Data Sheet Revision History

ChangeNo.	Page No.	Description of Change
1		Initial release of the device
2	1	Added the reference design for the bq2040
3	1	Added the reference design for the bq2040
4	1	Added the reference design for the bq2040
5	1	Added the reference design for the bq2040
6	1	Added the reference design for the bq2040
7	1	Added the reference design for the bq2040
8	1	Added the reference design for the bq2040
9	1	Added the reference design for the bq2040
10	1	Added the reference design for the bq2040
11	1	Added the reference design for the bq2040
12	1	Added the reference design for the bq2040
13	1	Added the reference design for the bq2040
14	1	Added the reference design for the bq2040
15	1	Added the reference design for the bq2040
16	1	Added the reference design for the bq2040
17	1	Added the reference design for the bq2040
18	1	Added the reference design for the bq2040
19	1	Added the reference design for the bq2040
20	1	Added the reference design for the bq2040

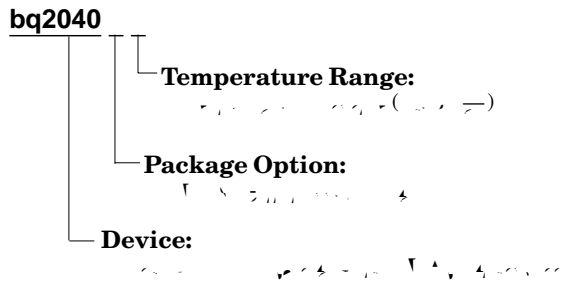
Notes:

1. The device is not recommended for use in applications where the ambient temperature is above 125°C.

2. The device is not recommended for use in applications where the ambient temperature is below -40°C.

3. The device is not recommended for use in applications where the ambient temperature is above 125°C and below -40°C.

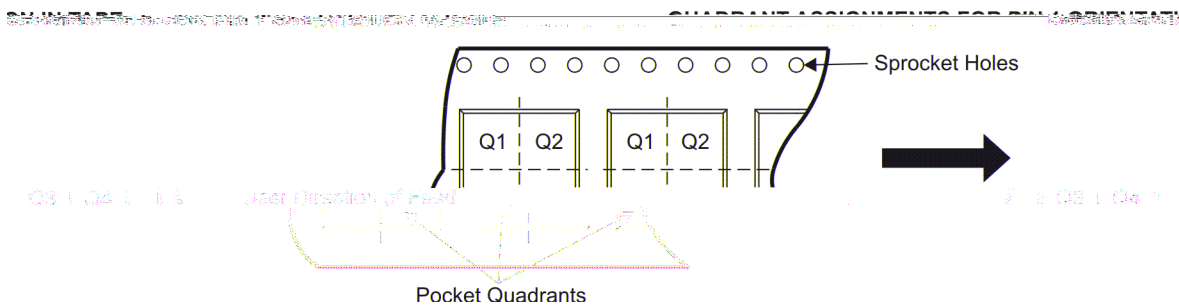
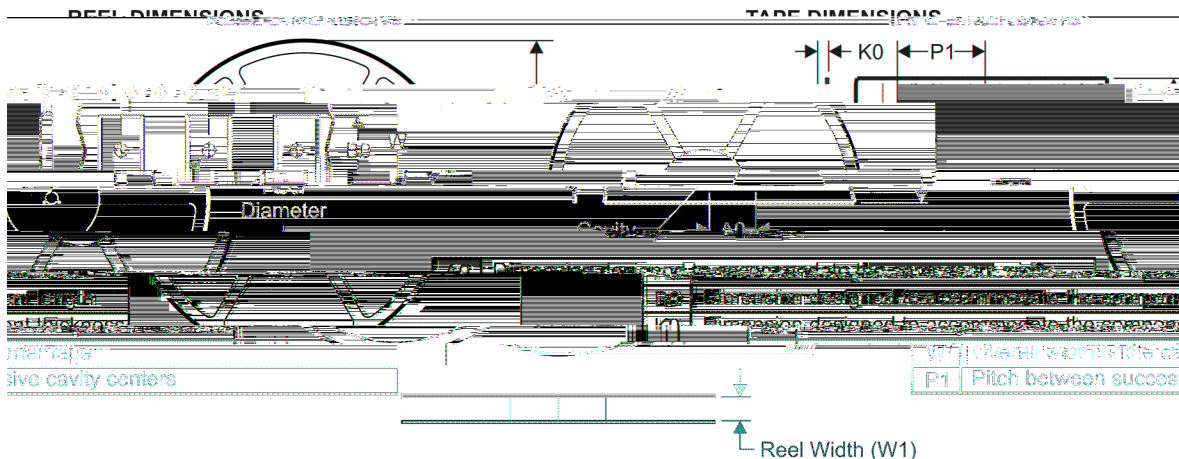
Ordering Information



PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type
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TAPE AND REEL INFORMATION



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
BQ2040SN-C408TR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
BQ2040SN-D111TR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
BQ2040SN-C408TR	SOIC	D	16	2500	346.0	346.0	33.0
BQ2040SN-D111TR	SOIC	D	16	2500	346.0	346.0	33.0

IMPORTANT NOTICE

Texas Instruments Incorporated