Benchmarq Products from Texas Instruments

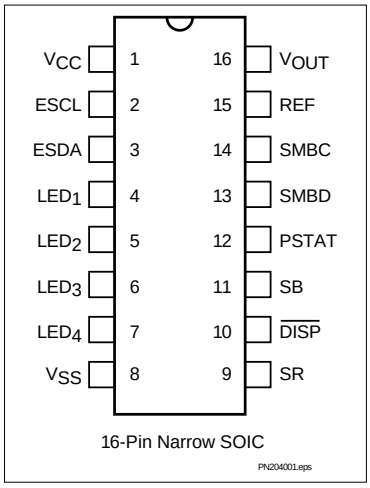
bq2040

Gas Gauge IC With SMBus Interface

Features

General Description

Pin Connections



16-Pin Narrow SOIC

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
$\overline{DISP}$	Display control input		

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Pin Descriptions

V_{CC} **Supply voltage input**

ESCL **Serial memory clock**

ESDA **Serial memory data and address**

LED_1–LED_4 **LED display segment outputs**

V_{SS} **Ground**

SR **Sense resistor input**

$\overline{DISP}$ **Display control input**

SB **Secondary battery input**

PSTAT **Protector status input**

SMBD **SMBus data**

SMBC **SMBus clock**

REF **Reference output for regulator**

V_{OUT} **Supply output**

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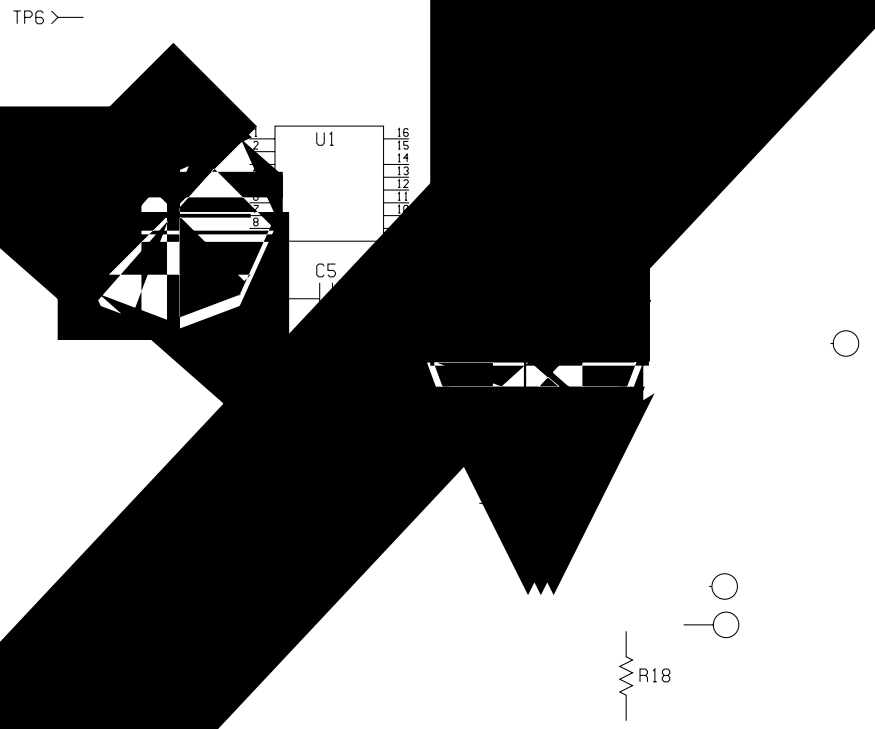


Table 1. Configuration Memory Map (Continued)

Parameter Name	Address	Description	Length	Units

Voltage Thresholds

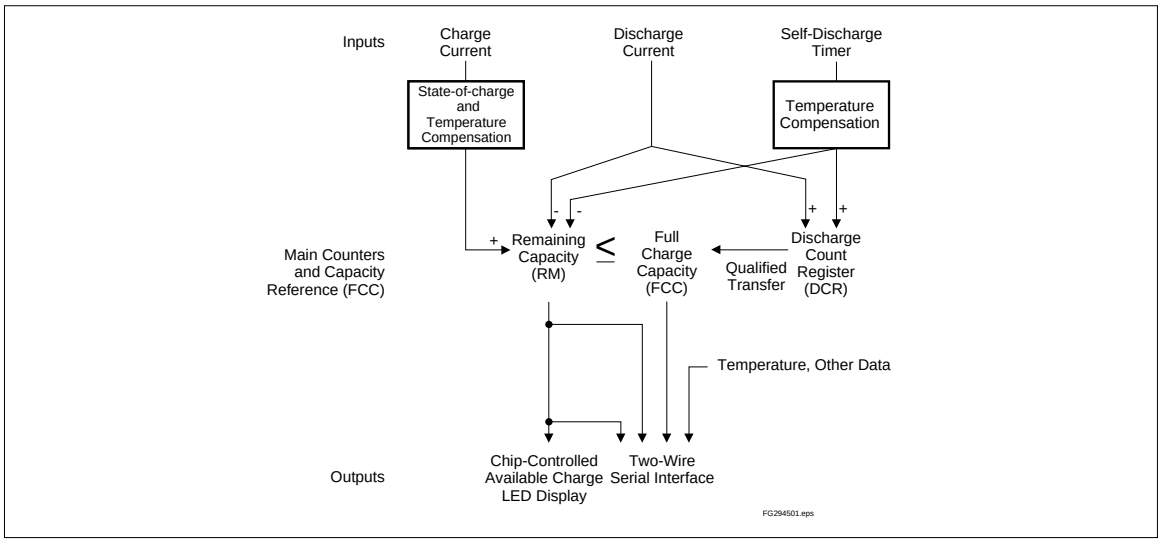


Figure 2. Operational Overview

%

2. DesignCapacity (DC):

%

3. RemainingCapacity (RM):

4. Discharge Count Register (DCR):

Charge Counting

A valid

Charge Suspension

2040 l l

- **Maximum Overcharge:** I
  l l l l l l l EE 0 3 0 3 l l M=FCC,
  F C l .
- **Overvoltage:** A l 5%
  2040 l C . 2040
  0 l C A l
  B . l 256l A
  105% C .
- **Overcurrent:** A l 25%
  2040 l C C . I C C
  1024l A, l 1l A
  l 256l A C C .
  2040 0
  l C A l B .
  l
  256l A.
- **Maximum Temperature**:
  l l l l l l l
  l ,
  O l A l
  l C A l B
  . O l A l
  l 43 C l l l
  l l 5°C.
- **PSTAT:** P A ≥1.5 ,
  0
  l C A l B
  D P A <1.0
  D .
- **Low Temperature:** l
  12 C (L F FLAG 2),
  l
  . O l 15°C,
- **Undervoltage:**
  ED F ,
  ED F EE0 5 /0 5 . O
  ED F,
  l
  L F .

Count Compensations

C l l M DC .
l l l -
M DC .

Charge Compensation

C , l l .
l :

1.) M = M * (EFC − E)

O C < F C P ,
EFC l 0.75 1.0.

2.) M = M * (E C − E)

O C ≥ F C P
E C l l l ( )
l 0.75 1.0.

E
l :

E = 0 < 30°C

E = 0.02 30°C ≤ < 40°C

E = 0.05 ≥ 40°C

E 0 l L-I .

Digital Magnitude Filter

2040 l l
-

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

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

Current-Sensing Error

Display

Host-to-bq2040 Messages (see Table 4)

ManufacturerAccess() (0x00)

RemainingCapacityAlarm() (0x01)

RemainingTimeAlarm() (0x02)

BatteryMode() (0x03)

Table 4. bq2040 Register Functions

Function	Code	Access	Units	Defaults[1]
[illegible]	[illegible]	[illegible]	-	-
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	-
[illegible]	[illegible]	[illegible]	[illegible]	-
[illegible]	[illegible]	[illegible]	[illegible]	-
[illegible]	[illegible]	[illegible]	[illegible]	-
[illegible]	[illegible]	[illegible]	[illegible]	-
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	-
[illegible]	[illegible]	[illegible]	[illegible]	-
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	-
[illegible]	[illegible]	[illegible]	[illegible]	-
[illegible]	[illegible]	[illegible]	[illegible]	-
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	-	[illegible]
[illegible]	[illegible]	[illegible]	-	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	-	-	-
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Note: [illegible]

Function	Code	Access	Units	Defaults[1]
			-	
			-	

■

■

AtRateTimeToFull() (0x05)

AtRateTimeToEmpty() (0x06)

AtRateOK() (0x07)

Temperature() (0x08)

Voltage() (0x09)

Current() (0x0a)

AverageCurrent() (0x0b)

MaxError() (0x0c)

RelativeStateOfCharge() (0x0d)

RelativeStateOfCharge is only valid for battery capacities more than 1504mAh and less than 10,400mAh.

AbsoluteStateOfCharge() (0x0e)

Absolute StateOfCharge is only valid for battery capacities more than 1504mAh and less than 10,400mAh.

RemainingCapacity() (0x0f)

FullChargeCapacity() (0x10)

RunTimeToEmpty() (0x11)

AverageTimeToEmpty() (0x12)

AverageTimeToFull() (0x13)

ChargingCurrent() (0x14)

ChargingVoltage() (0x15)

BatteryStatus() (0x16)

Table 5. Status Register

Alarm Bits	
Status Bits	
Error Code	

CycleCount() (0x17)

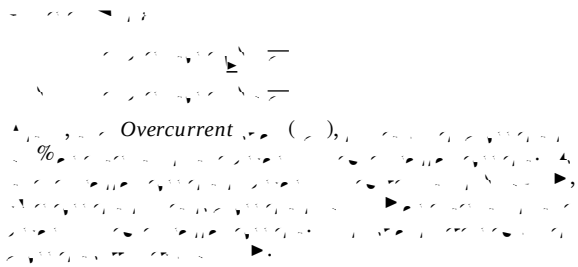
DesignCapacity() (0x18)

End of Discharge Voltage1 (0x3e)

End of Discharge VoltageF (0x3f)

FLAGS1&2() (0x2f)

FLAGS2



First End-of-Discharge Voltage

Final End-of-Discharge Voltage

Error Codes and Status Bits

SBD Seal

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

Error	Code	Access	Description

Note:

Alarm Bits

Bit Name	Set When:	Reset When:
[illegible]	Δ /Δ . (**Note: ΔT/Δt and current taper are valid charge terminations**.)	Δ /Δ
[illegible]	Δ /Δ ,	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible] (r).	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

Status Bits

Bit Name	Set When:	Reset When:
[illegible]	( ).	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible] %

Table 10. Example Register Contents

Description	EEPROM Address		EEPROM Hex Contents		Example Values	Notes
	Low Byte	High Byte	Low Byte	High Byte		
[illegible]	[illegible]		[illegible]		[illegible]	[illegible]
[illegible]	[illegible]				[illegible]	[illegible]
[illegible]	[illegible]	[illegible]			[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]				[illegible]
[illegible]	[illegible]	[illegible]			[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]			[illegible]	[illegible]
[illegible]	[illegible]	[illegible]				[illegible]
[illegible]	[illegible]	[illegible]			[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]			[illegible]	[illegible]
[illegible]	[illegible]	[illegible]			[illegible]	[illegible]
[illegible]	[illegible]	[illegible]				[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] %	[illegible]				%	[illegible]

Table 10. Example Register Contents (Continued)

Description	EEPROM Address		EEPROM Hex Contents		Example Values	Notes
	Low Byte	High Byte	Low Byte	High Byte		

Note:

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
[illegible]	[illegible]												
[illegible]	[illegible]												
[illegible]	[illegible]												
[illegible]	[illegible]												

Absolute Maximum Ratings

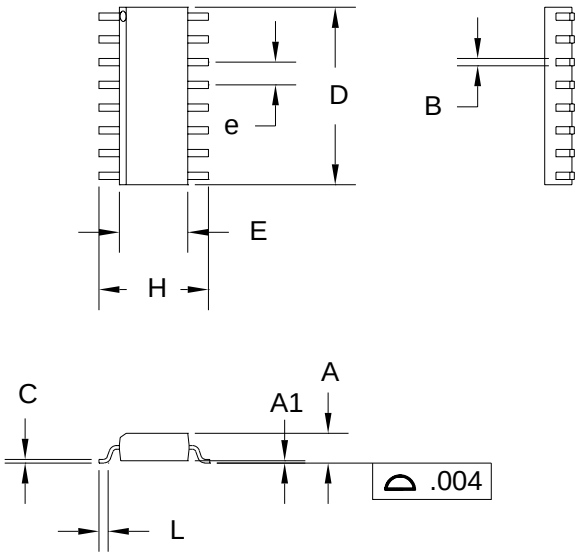
Symbol	Parameter	Minimum	Maximum	Unit	Notes
٢	•	- .	+, .	٢	
►	•	- .	+, .	٢	
•	•	- .	+ .	٢	( )
٢ .	•	- .	+, .	٢	٢ Ω
, .	-		+,	—	

Note: **Absolute Maximum Ratings**

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

Symbol	Parameter	Minimum	Typical	Maximum	Unit	Notes
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] ≥ [illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

16-Pin SOIC Narrow (SN)



16-Pin SN (SOIC Narrow)

Dimension	Minimum	Maximum
▶	.	.
▶	.	.
▲	.	.
◢	.	.
	.	.
▬	⅛	⅛
◢	.	.
	..	..
	.	.

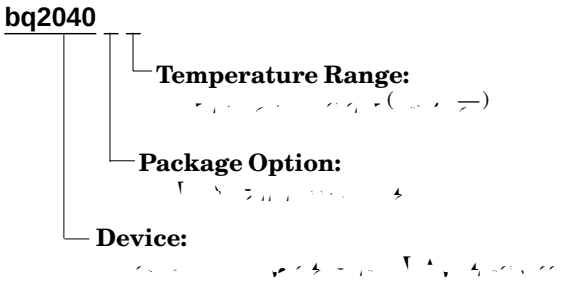
▶

Data Sheet Revision History

ChangeNo.	Page No.	Description of Change
		approximately

Notes:

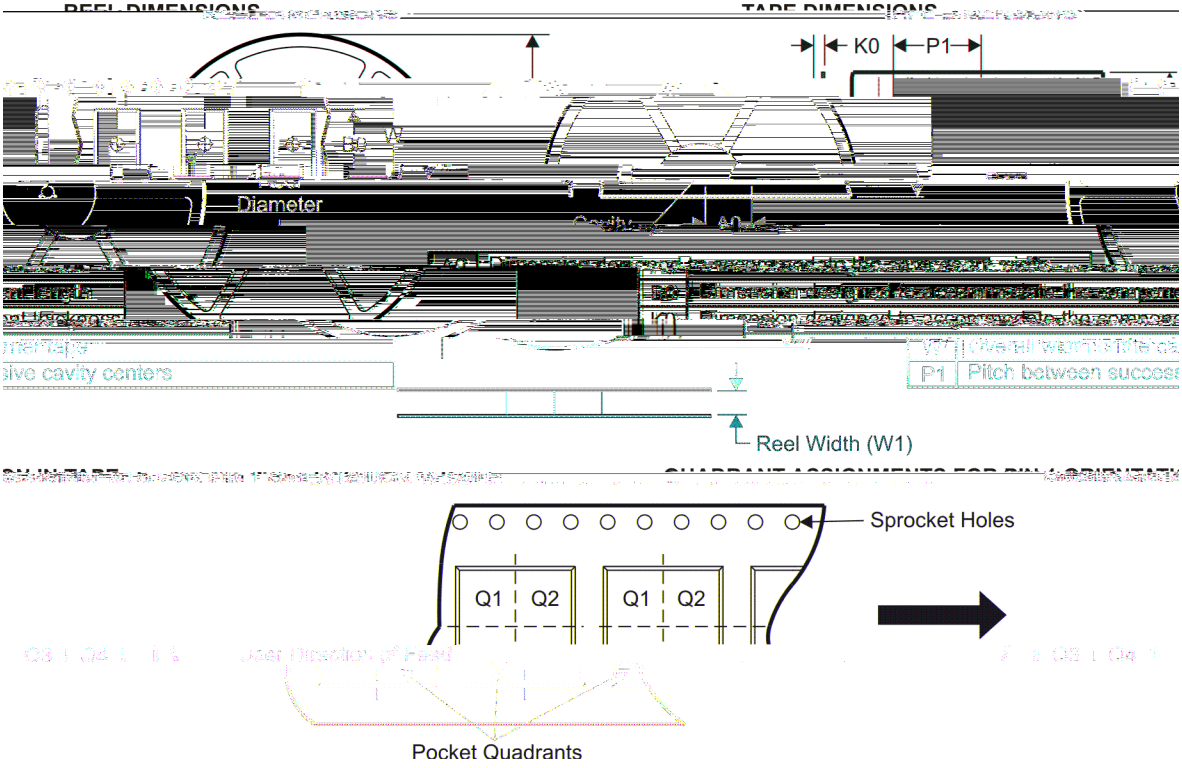
Ordering Information



PACKAGING INFORMATION

Orderable Device	Status [1]	Package Type

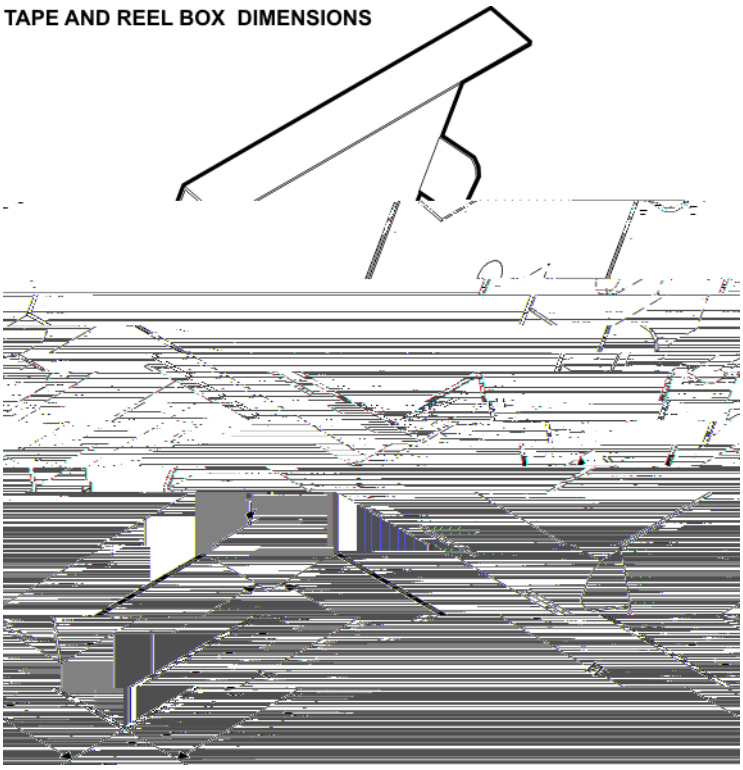
TAPE AND REEL INFORMATION



*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

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