SBS 1.1-COMPLIANT GAS GAUGE ENABLED WITH IMPEDANCE TRACK™ TECHNOLOGY FOR USE WITH THE bq29330

FEATURES

- **Next Generation Patented Impedance Track™ Technology accurately Measures Available Charge in Li-Ion and Li-Polymer Batteries**
- **Better than 1% Error Over Lifetime of the Battery**
- **Instant Accuracy – No Learning Cycle Required**
- **Supports the Smart Battery Specification SBS V1.1**
- **Powerful 8-Bit RISC CPU With Ultra-Low Power Modes**
- **Works With the TI bq29330 Analog Front-End (AFE) Protection IC to Provide Complete Pack Electronics Solution**
- **Full Array of Programmable Protection Features**
  - **Voltage, Current and Temperature**
- **Fully Integrated High Accurate Clock**
- **Flexible Configuration for 2 to 4 Series Li-Ion and Li-Polymer Cells**
- **Integrated Field Programmable FLASH Memory Eliminates the Need for External Configuration Memory**
- **Smart Battery Charger Control Feature**
- **Two 16-Bit Delta-Sigma Converter**
  - **Accurate Voltage and Temperature Measurements**
  - **Integrating Coloumb Counter for Charge Flow**
    - **Better Than 0.65 nVh of Resolution**
    - **Self-Calibrating**
- **Supports SHA-1 Authentication**
- **20-Pin TSSOP (PW)**

APPLICATIONS

- **Notebook PCs**
- **Medical and Test Equipment**
- **Portable Instrumentation**

DESCRIPTION

The bq20z70 SBS-compliant gas gauge IC, incorporating patented Impedance Track™ technology, is designed for battery-pack or in-system installation. The bq20z70 measures and maintains an accurate record of available charge in Li-ion or Li-polymer batteries using its integrated high-performance analog peripherals. The bq20z70 monitors capacity change, battery impedance, open-circuit voltage, and other critical parameters of the battery pack, and reports the information to the system host controller over a serial-communication bus. It is designed to work with the bq29330 analog front-end (AFE) protection IC to maximize functionality and safety, and minimize component count and cost in smart battery circuits.

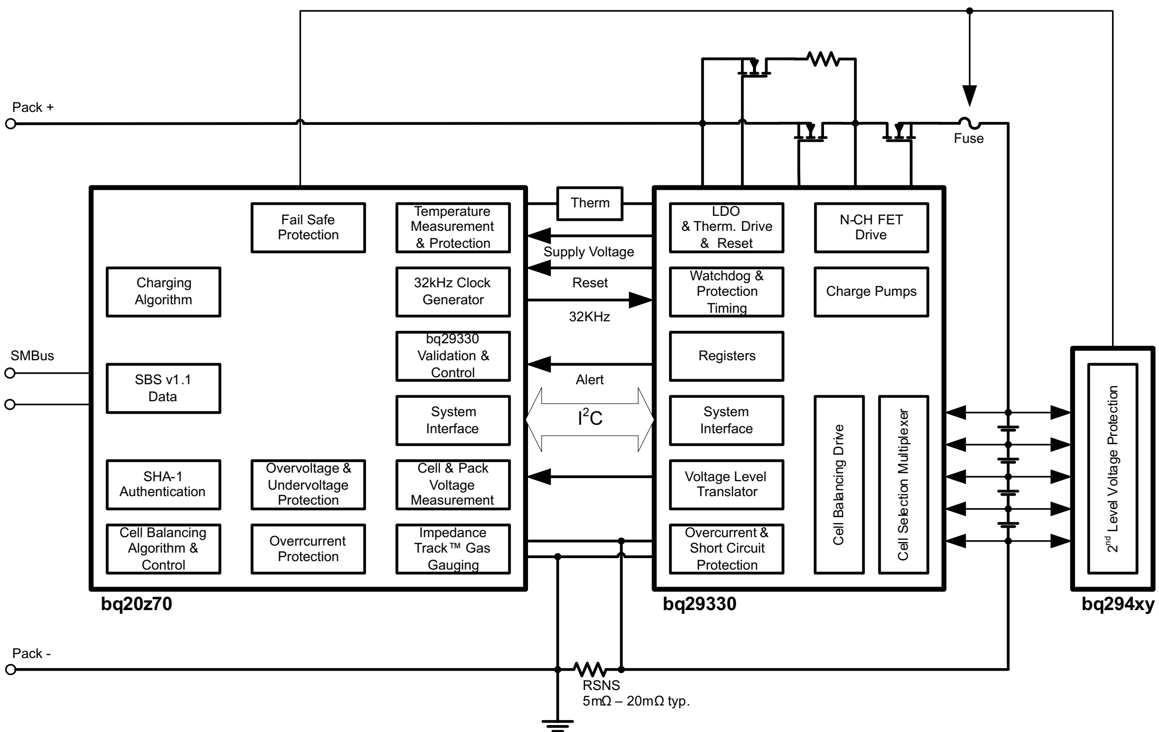
The Impedance Track technology continuously analyzes the battery impedance, resulting in superior gas-gauging accuracy. This enables remaining capacity to be calculated with discharge rate, temperature, and cell aging all accounted for during each stage of every cycle.

AVAILABLE OPTIONS

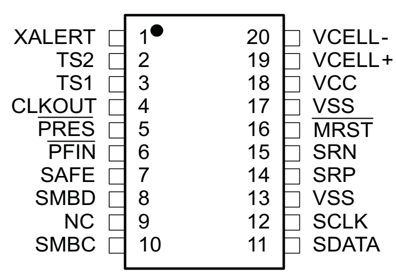
T_A	PACKAGE (1)	
	20-PIN TSSOP (PW) Tube	20-PIN TSSOP (PW) Tape and Reel
–40°C to 85°C	bq20z70PW (2)	bq20z70PWR (3)

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI website at www.ti.com.
(2) A single tube quantity is 50 units.
(3) A single reel quantity is 2000 units

SYSTEM PARTITIONING DIAGRAM



TSSOP (PW)
(TOP VIEW)



TERMINAL FUNCTIONS

TERMINAL		I/O (1)	DESCRIPTION
NO.	NAME		
1	XALERT	I	Alert interrupt input from bq29330. Connect directly to bq29330 XALERT pin
2	TS2	I	2nd thermistor voltage input connection to monitor temperature
3	TS1	I	1st thermistor voltage input connection to monitor temperature
4	CLKOUT	O	32.768kHz output for bq29330 watchdog. Connect directly to bq29330 WDI pin
5	$\overline{\text{PRES}}$	I	Active low input to sense system insertion
6	$\overline{\text{PFIN}}$	I	Active low input to sense secondary protector output status
7	SAFE	O	Active high output to enforce additional level of safety, e.g. fuse blow
8	SMBD	I/OD	SMBus data open drain bidirectional pin used for communication with bq20z70
9	NC	–	Not used - leave floating
10	SMBC	I/OD	SMBus clock open drain bidirectional pin used for communication with bq20z70
11	SDATA	I/OD	Data transfer line from and to bq29330. Connect directly to SDATA pin of bq29330
12	SCLK	I/OD	Data clock line to bq29330. Connect directly to SCLK pin of bq29330
13	VSS	I/OD	VSS
14	SRP	IA	Connection for a small-value resistor to monitor the battery charge and discharge current flow
15	SRN	IA	Connection for a small-value resistor to monitor the battery charge and discharge current flow
16	$\overline{\text{MRST}}$	I	Master reset input that forces the device into reset when held low. Connect directly to XRST pin of bq29330
17	VSS	P	Negative supply. Both VSS needs to be connected together
18	VCC	P	Positive supply
19	VCELL+	I	Positive differential cell input. Connect directly to CELL+ pin of bq29330
20	VCELL-	I	Negative differential cell input. Connect directly to CELL- pin of bq29330

(1) I = Input, IA = Analog input, I/O = Input/output, I/OD = Input/Open-drain output, O = Output, OA = Analog output, P = Power

ABSOLUTE MAXIMUM RATINGS

over operating free-air temperature range (unless otherwise noted)[(1)]

		RANGE
V_{CC} relative to V_{SS} [(2)]	Supply voltage range on VCC pin	–0.3 V to 2.75 V
$V_{(IOD)}$ relative to V_{SS} [(2)]	XALERT, $\overline{\text{PFIN}}$, SAFE, SMBD, SMBC, SDATA, SCLK,	–0.3 V to 6.0 V
V_I relative to V_{SS} [(2)]	TS2, TS1, CLKOUT, $\overline{\text{PRES}}$, SRP, SRN, $\overline{\text{MRST}}$, VCELL+,VCELL-	–0.3 V to V_{CC} + 0.3 V
T_A	Operating free-air temperature range	–40°C to 85°C
T_{stg}	Storage temperature range	–65°C to 150°C

(1) Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under recommended operating conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) V_{SS} refers to Voltage at VSS pin.

ELECTRICAL CHARACTERISTICS

V_{CC} = 2.4 V to 2.6 V, T_A = -40°C - 85°C (unless otherwise noted)

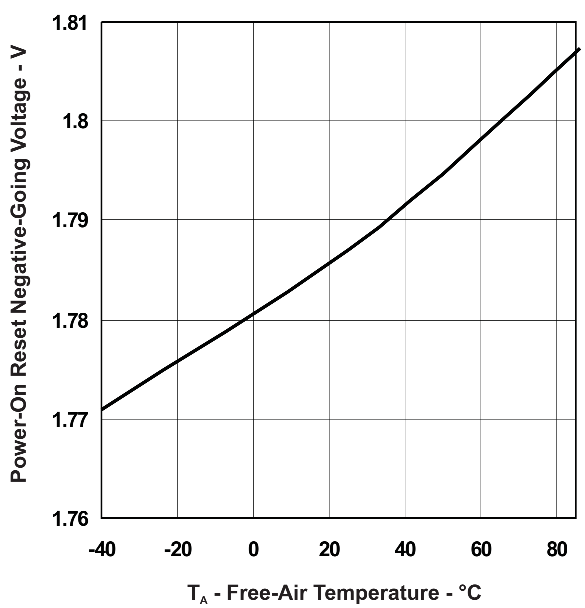
PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{DD}	Supply voltage	VDDA and VDDD	2.4	2.5	2.6	V
I_{DD}	Operating mode current	No flash programming		400 (1)		μA
		bq20z70 + bq29330		475		
$I_{(SLP)}$	Low-power storage mode current	Sleep mode		8 (1)		μA
		bq20z70 + bq29330		48		
$I_{(SLP)}$	Shutdown Current	Shutdown Mode		0.1 (1)		μA
		bq20z70 + bq29330		0.2		
V_{OL}	Output voltage low CLKOUT, SAFE, SMBD, SMBC, SDATA, SCLK	I_{OL} = 7 mA			0.4	V
V_{OH}	Output high voltage CLKOUT, SAFE, SMBD,SMBC, SDATA, SCLK	I_{OH} = –0.5 mA	V_{CC} – 0.5			V
V_{IL}	Input voltage low $\overline{PRES}$, $\overline{PFIN}$, SMBD, SMBC, SDATA, $\overline{MRST}$				0.8	V
V_{IH}	Input voltage high $\overline{PRES}$, $\overline{PFIN}$, SMBD, SMBC, SDATA, $\overline{MRST}$		2.0			V
C_{IN}	Input capacitance			5		pF
$V_{(AI1)}$	Input voltage range TS1, TS2, VCELL+, VCELL-		– 0.2		0.8 x V_{CC}	V
$V_{(AI2)}$	Input voltage range SRP, SRN		– 0.2		0.2	
$Z_{(AI1)}$	Input impedance TS1, TS2, VCELL+, VCELL -	0 V – 1 V	8			MΩ
$Z_{(AI2)}$	Input impedance SRP, SRN	0 V – 1 V	2.5			MΩ

(1) This value does not include the bq29330

POWER-ON RESET

V_{CC} = 2.4 V to 2.6 V, T_A = –40°C to 85°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{IT-}	Negative-going voltage input		1.7	1.8	1.9	V
V_{HYS}	Power-on reset hysteresis		50	125	200	mV



INTEGRATING ADC (Coulomb Counter) CHARACTERISTICS

V_{CC} = 2.4 V to 2.6 V, T_A = –40°C to 85°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$V_{(SR)}$	Input voltage range, $V_{(SRN)}$ and $V_{(SRP)}$	$V_{(SR)}$ = V(SRP) – V(SRN)	–0.20		0.20	V
$V_{(SROS)}$	Input offset	T_A =25°C to 85°C		10		μV
INL	Integral nonlinearity error			±0.007%	±0.037%	

OSCILLATOR

V_{CC} = 2.4 V to 2.6 V, T_A = –40°C to 85°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
HIGH FREQUENCY OSCILLATOR						
$f_{(OSC)}$	Operating frequency			4.194		MHz
$f_{(EIO)}$	Frequency error [(1)(2)]		-3%	0.25%	3%	
		T_A = 20°C to 70°C	-2%	0.25%	2%	
$f_{(sxo)}$	Start-up time [(3)]			2.5	5	ms
LOW FREQUENCY OSCILLATOR						
$f_{(LOSC)}$	Operating frequency			32.768		kHz
$f_{(LEIO)}$	Frequency error [(2)(4)]		-2.5%	0.25%	2.5%	
		T_A = 20°C to 70°C	-1.5%	0.25%	1.5%	
$f_{(Lsxo)}$	Start-up time [(5)]				500	μs

(1) The frequency error is measured from 4.194 MHz.
(2) The frequency drift is included and measured f rom the trimmed frequency at V_{CC} = 2.5 V, T_A = 25°C.
(3) The start-up time is defined as the time it takes for the oscillator output frequency to be within 1% of the specified frequency.
(4) The frequency error is measured from 32.768 kHz.
(5) The start-up time is defined as the time it takes for the oscillator output frequency to be ±3%.

DATA FLASH MEMORY CHARACTERISTICS

V_{CC} = 2.4 V to 2.6 V, T_A = –40°C to 85°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{DR}	Data retention	See [(1)]	10			Years
	Flash programming write-cycles	See [(1)]	20,000			Cycles
$t_{(WORDPROG)}$	Word programming time	See [(1)]			2	ms
$I_{(DDPROG)}$	Flash-write and erase supply current	See [(1)]		5	10	mA

(1) Specified by design. Not production tested

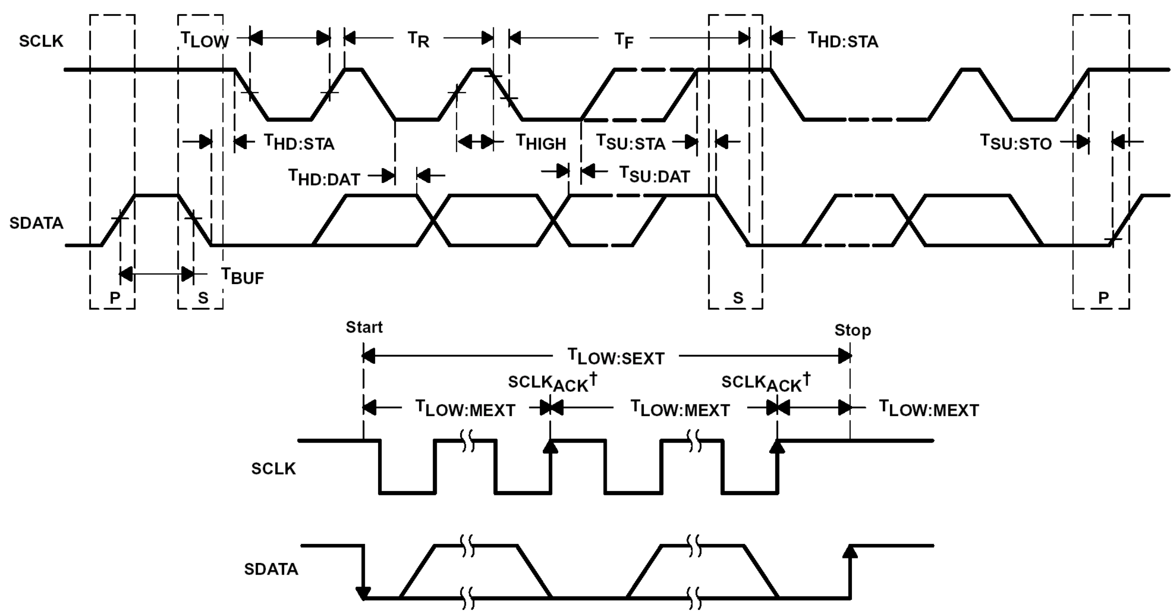
SMBus TIMING SPECIFICATIONS

V_{CC} = 2.4 V to 2.6 V, T_A = –40°C to 85°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{SMB}	SMBus operating frequency	Slave mode, SMBC 50% duty cycle	10		100	kHz
f_{MAS}	SMBus master clock frequency	Master mode, no clock low slave extend		51.2		
t_{BUF}	Bus free time between start and stop		4.7			μs
$t_{HD:STA}$	Hold time after (repeated) start		4			
$t_{SU:STA}$	Repeated start setup time		4.7			
$t_{SU:STO}$	Stop setup time		4			
$t_{HD:DAT}$	Data hold time	Receive mode	0			ns
		Transmit mode	300			
$t_{SU:DAT}$	Data setup time		250			
$t_{TIMEOUT}$	Error signal/detect	See (1)	25		35	ms
t_{LOW}	Clock low period		4.7			μs
t_{HIGH}	Clock high period	See (2)	4		50	
$t_{LOW:SEXT}$	Cumulative clock low slave extend time	See (3)			25	ms
$t_{LOW:MEXT}$	Cumulative clock low master extend time	See (4)			10	
t_F	Clock/data fall time	(V_{ILMAX} – 0.15 V) to (V_{IHMIN} + 0.15 V)			300	ns
t_R	Clock/data rise time	0.9 VCC to (VILMAX – 0.15 V)			1000	

(1) The bq20z70 times out when any clock low exceeds $t_{TIMEOUT}$.
(2) $t_{HIGH:MAX}$. is minimum bus idle time. SMBC = 1 for t > 50 μs causes reset of any transaction involving the bq20z70 that is in progress.
(3) $t_{LOW:SEXT}$ is the cumulative time a slave device is allowed to extend the clock cycles in one message from initial start to the stop.
(4) $t_{LOW:MEXT}$ is the cumulative time a master device is allowed to extend the clock cycles in one message from initial start to the stop.

SMBus TIMING DIAGRAM



† $SCLK_{ACK}$ is the acknowledge-related clock pulse generated by the master.

FEATURE SET

Primary (1st Level) Safety Features

The bq20z70 supports a wide range of battery and system protection features that can easily be configured. The primary safety features include:

- Cell over/under voltage protection
- Charge and Discharge overcurrent
- Short Circut
- Charge and Discharge Overtemperature
- AFE Watchdog

Secondary (2nd Level) Safety Features

The secondary safety features of the bq20z70 can be used to indicate more serious faults via the SAFE (pin 7). This pin can be used to blow an in-line fuse to permanently disable the battery pack from charging or discharging. The secondary safety protection features include:

- Safety overvoltage
- Safety overcurrent in Charge and Discharge
- Safety overtemperature in Charge and Discharge
- Charge FET and 0 Volt Charge FET fault
- Discharge FET fault
- AFE communication fault

Charge Control Features

The bq20z70 charge control features include:

- Reports the appropriate charging current needed for constant current charging and the appropriate charging voltage needed for constant voltage charging to a smart charger using SMBus broadcasts.
- Determines the chemical state of charge of each battery cell using Impedance Track™ and can reduce the charge difference of the battery cells in fully charged state of the battery pack gradually using cell balancing algorithm during charging. This prevents fully charged cells from overcharging and causing excessive degradation and also increases the usable pack energy by preventing premature charge termination
- Supports pre-charging/zero-volt charging
- Support fast charging
- Supports charge inhibit and charge suspend if battery pack temperature is out of temperature range
- Reports charging fault and also indicate charge status via charge and discharge alarms.

Gas Gauging

The bq20z70 uses the Impedance Track™ Technology to measure and calculate the available charge in battery cells. The achievable accuracy is better than 1% error over the lifetime of the battery and there is no full charge discharge learning cycle required.

See *Theory and Implementation of Impedance Track Battery Fuel-Gauging Algorithm* application note (SLUA364) for further details.

Authentication

The bq20z70 supports authentication by the host using SHA-1.

FEATURE SET (continued)

Power Modes

The bq20z70 supports 3 different power modes to reduce power consumption:

- In Normal Mode, the bq20z70 performs measurements, calculations, protection decisions and data updates in 1 second intervals. Between these intervals, the bq20z70 is in a reduced power stage.
- In Sleep Mode, the bq20z70 performs measurements, calculations, protection decisions and data update in adjustable time intervals. Between these intervals, the bq20z70 is in a reduced power stage. The bq20z70 has a wake function that enables exit from Sleep mode, when current flow or failure is detected.
- In Shutdown Mode the bq20z70 is completely disabled.

CONFIGURATION

Oscillator Function

The bq20z70 fully integrates the system oscillators. Therefore, the bq20z70 requires no external components for this feature.

System Present Operation

The bq20z70 pulls the PU pin high periodically (1 s). Connect this pin to the $\overline{\text{PRES}}$ pin of the bq20z70 via a resistor of approximately 5 kΩ. The bq20z70 measures the $\overline{\text{PRES}}$ input during the PU-active period to determine its state. If $\overline{\text{PRES}}$ input is pulled to ground by external system, the bq20z70 detects this as system present.

BATTERY PARAMETER MEASUREMENTS

The bq20z70 uses an integrating delta-sigma analog-to-digital converter (ADC) for current measurement, and a second delta-sigma ADC for individual cell and battery voltage, and temperature measurement.

Charge and Discharge Counting

The integrating delta-sigma ADC measures the charge/discharge flow of the battery by measuring the voltage drop across a small-value sense resistor between the SR1 and SR2 pins. The integrating ADC measures bipolar signals from -0.25 V to 0.25 V. The bq20z70 detects charge activity when $V_{SR} = V_{(SR1)}$-$V_{(SR2)}$is positive and discharge activity when $V_{SR} = V_{(SR1)}$-$V_{(SR2)}$ is negative. The bq20z70 continuously integrates the signal over time, using an internal counter. The fundamental rate of the counter is 0.65 nVh.

Voltage

The bq20z70 updates the individual series cell voltages through the bq29330 at one second intervals. The bq20z70 configures the bq29330 to connect the selected cell, cell offset, or bq29330 VREF to the CELL pin of the bq29330, which is required to be connected to VIN of the bq20z70. The internal ADC of the bq20z70 measures the voltage, scales and calibrates it appropriately. This data is also used to calculate the impedance of the cell for the Impedance Track™ gas-gauging.

Current

The bq20z70 uses the SRP and SRN inputs to measure and calculate the battery charge and discharge current using a 5 mΩ to 20 mΩ typ. sense resistor.

Auto Calibration

The bq20z70 provides an auto-calibration feature to cancel the voltage offset error across SRN and SRP for maximum charge measurement accuracy. The bq20z70 performs auto-calibration when the SMBus lines stay low continuously for a minimum of 5 s.

Temperature

The bq20z70 has an internal temperature sensor and 2 external temperature sensor inputs TS1 and TS2 used in conjunction with two identical NTC thermistors (default are Semitec 103AT) to sense the battery enviromental temperature. The bq20z70 can be configured to use internal or external temperature sensors.

FEATURE SET (continued)

COMMUNICATIONS

The bq20z70 uses SMBus v1.1 with Master Mode and package error checking (PEC) options per the SBS specification.

SMBus On and Off State

The bq20z70 detects an SMBus off state when SMBC and SMBD are logic-low for ≥ 2 seconds. Clearing this state requires either SMBC or SMBD to transition high. Within 1 ms, the communication bus is available.

FEATURE SET (continued)

SBS Commands

Table 1. SBS COMMANDS

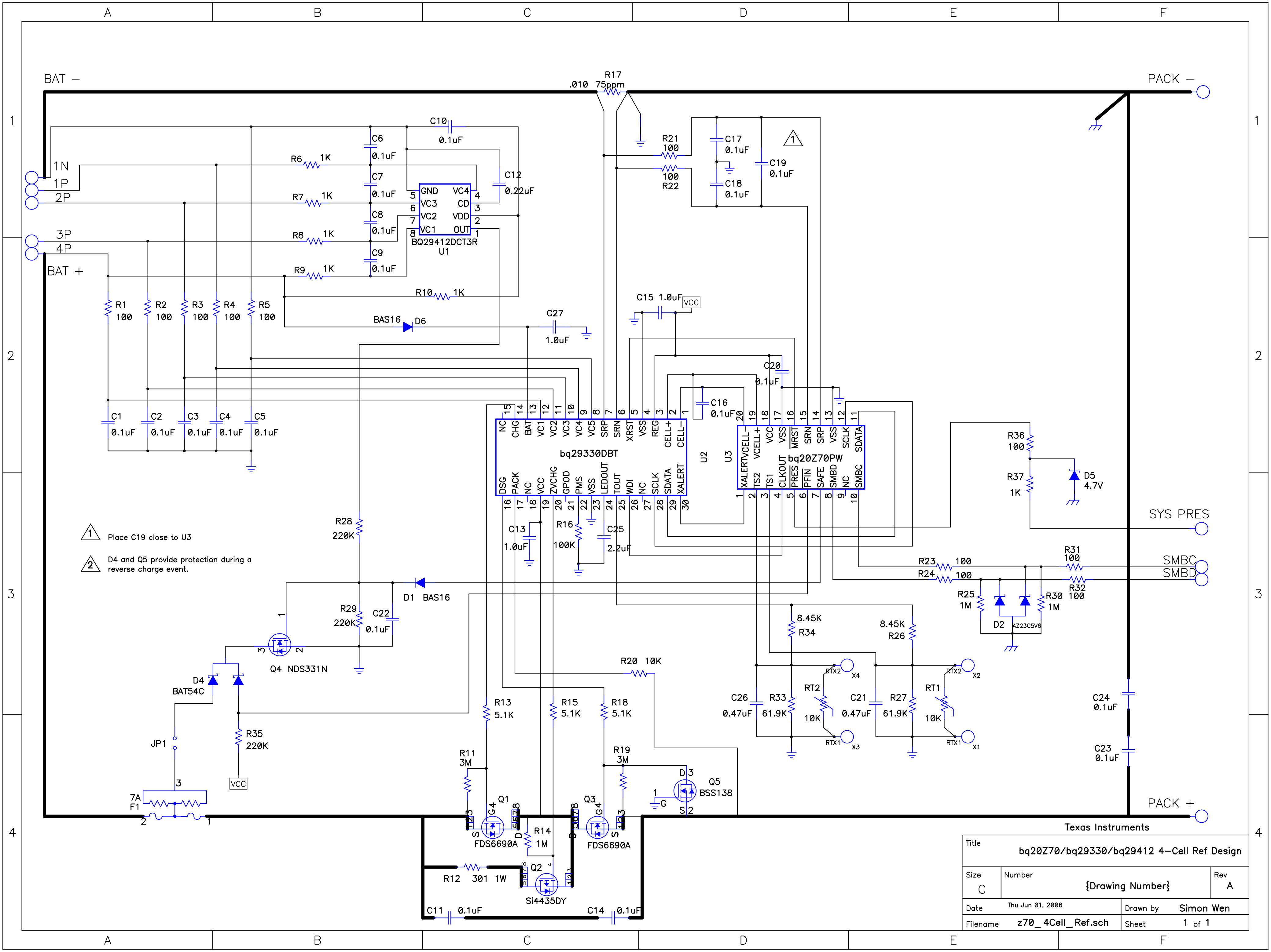
SBS Cmd	Mode	Name	Format	Size in Bytes	Min Value	Max Value	Default Value	Unit
0x00	R/W	ManufacturerAccess	hex	2	0x0000	0xffff	—	
0x01	R/W	RemainingCapacityAlarm	unsigned int	2	0	65535	—	mAh or 10mWh
0x02	R/W	RemainingTimeAlarm	unsigned int	2	0	65535	—	min
0x03	R/W	BatteryMode	hex	2	0x0000	0xffff	—	
0x04	R/W	AtRate	signed int	2	-32768	32767	—	mA or 10mW
0x05	R	AtRateTimeToFull	unsigned int	2	0	65535	—	min
0x06	R	AtRateTimeToEmpty	unsigned int	2	0	65535	—	min
0x07	R	AtRateOK	unsigned int	2	0	65535	—	
0x08	R	Temperature	unsigned int	2	0	65535	—	0.1°K
0x09	R	Voltage	unsigned int	2	0	20000	—	mV
0x0a	R	Current	signed int	2	-32768	32767	—	mA
0x0b	R	AverageCurrent	signed int	2	-32768	32767	—	mA
0x0c	R	MaxError	unsigned int	1	0	100	—	%
0x0d	R	RelativeStateOfCharge	unsigned int	1	0	100	—	%
0x0e	R	AbsoluteStateOfCharge	unsigned int	1	0	100	—	%
0x0f	R/W	RemainingCapacity	unsigned int	2	0	65535	—	mAh or 10mWh
0x10	R	FullChargeCapacity	unsigned int	2	0	65535	—	mAh or 10mWh
0x11	R	RunTimeToEmpty	unsigned int	2	0	65535	—	min
0x12	R	AverageTimeToEmpty	unsigned int	2	0	65535	—	min
0x13	R	AverageTimeToFull	unsigned int	2	0	65535	—	min
0x14	R	ChargingCurrent	unsigned int	2	0	65535	—	mA
0x15	R	ChargingVoltage	unsigned int	2	0	65535	—	mV
0x16	R	BatteryStatus	unsigned int	2	0x0000	0xffff	—	
0x17	R/W	CycleCount	unsigned int	2	0	65535	—	
0x18	R/W	DesignCapacity	unsigned int	2	0	65535	—	mAh or 10mWh
0x19	R/W	DesignVoltage	unsigned int	2	7000	16000	14400	mV
0x1a	R/W	SpecificationInfo	unsigned int	2	0x0000	0xffff	0x0031	
0x1b	R/W	ManufactureDate	unsigned int	2	0	65535	0	
0x1c	R/W	SerialNumber	hex	2	0x0000	0xffff	0x0001	
0x20	R/W	ManufacturerName	String	11+1	—	—	Texas Instruments	ASCII
0x21	R/W	DeviceName	String	7+1	—	—	bq20z70	ASCII
0x22	R/W	DeviceChemistry	String	4+1	—	—	LION	ASCII
0x23	R	ManufacturerData	String	14+1	—	—	—	ASCII
0x2f	R/W	Authenticate	String	20+1	—	—	—	ASCII
0x3c	R	CellVoltage4	unsigned int	2	0	65535	—	mV
0x3d	R	CellVoltage3	unsigned int	2	0	65535	—	mV
0x3e	R	CellVoltage2	unsigned int	2	0	65535	—	mV
0x3f	R	CellVoltage1	unsigned int	2	0	65535	—	mV

Table 2. EXTENDED SBS COMMANDS

SBS Cmd	Mode	Name	Format	Size in Bytes	Min Value	Max Value	Default Value	Unit
0x45	R	AFEData	String	11+1	—	—	—	ASCII
0x46	R/W	FETControl	hex	1	0x00	0xff	—	
0x4f	R	StateOfHealth	unsigned int	1	0	100	—	%
0x51	R	SafetyStatus	hex	2	0x0000	0xffff	—	
0x53	R	PFStatus	hex	2	0x0000	0xffff	—	
0x54	R	OperationStatus	hex	2	0x0000	0xffff	—	
0x55	R	ChargingStatus	hex	2	0x0000	0xffff	—	
0x57	R	ResetData	hex	2	0x0000	0xffff	—	
0x5a	R	PackVoltage	unsigned int	2	0	65535	—	mV
0x5d	R	AverageVoltage	unsigned int	2	0	65535	—	mV
0x60	R/W	UnSealKey	hex	4	0x00000000	0xffffffff	—	
0x61	R/W	FullAccessKey	hex	4	0x00000000	0xffffffff	—	
0x62	R/W	PFKey	hex	4	0x00000000	0xffffffff	—	
0x63	R/W	AuthenKey3	hex	4	0x00000000	0xffffffff	—	
0x64	R/W	AuthenKey2	hex	4	0x00000000	0xffffffff	—	
0x65	R/W	AuthenKey1	hex	4	0x00000000	0xffffffff	—	
0x66	R/W	AuthenKey0	hex	4	0x00000000	0xffffffff	—	
0x70	R/W	ManufacturerInfo	String	8+1	—	—	—	
0x71	R/W	SenseResistor	unsigned int	2	0	65535	—	μΩ
0x77	R/W	DataFlashSubClassID	hex	2	0x0000	0xffff	—	
0x78	R/W	DataFlashSubClassPage1	hex	32	—	—	—	
0x79	R/W	DataFlashSubClassPage2	hex	32	—	—	—	
0x7a	R/W	DataFlashSubClassPage3	hex	32	—	—	—	
0x7b	R/W	DataFlashSubClassPage4	hex	32	—	—	—	
0x7c	R/W	DataFlashSubClassPage5	hex	32	—	—	—	
0x7d	R/W	DataFlashSubClassPage6	hex	32	—	—	—	
0x7e	R/W	DataFlashSubClassPage7	hex	32	—	—	—	
0x7f	R/W	DataFlashSubClassPage8	hex	32	—	—	—	

Application Schematic

The application schematic is on the following page.


BAT −
PACK −
BAT +
PACK +
1N
1P
2P
3P
4P
R17 .010 75ppm
BQ29412DCT3R
U1
GND VC3 VC2 VC1 VC4 CD VDD OUT
bq29330DBT
U2
NC CHG BAT VC1 VC2 VC3 VC4 VC5 SRP SRN XRST VSS REG CELL+ CELL−
DSG PACK NC VCC ZVCHG GPOD PMS VSS LEDOUT TOUT WDI NC SCLK SDATA XALERT
U3
bq20Z70PW
XALERT VCELL− VCELL+ VCC VSS MRST SRN SRP VSS SCLK SDATA
TS2 TS1 CLKOUT PRES PFIN SAFE SMBD NC SMBC
R1 100
R2 100
R3 100
R4 100
R5 100
R6 1K
R7 1K
R8 1K
R9 1K
R10 1K
C1 0.1uF
C2 0.1uF
C3 0.1uF
C4 0.1uF
C5 0.1uF
C6 0.1uF
C7 0.1uF
C8 0.1uF
C9 0.1uF
C10 0.1uF
C12 0.22uF
C15 1.0uF
C16 0.1uF
C17 0.1uF
C18 0.1uF
C19 0.1uF
C20 0.1uF
C27 1.0uF
R21 100
R22 100
BAS16 D6
VCC
R36 100
R37 1K
D5 4.7V
SYS PRES
SMBC
SMBD
R23 100
R24 100
R31 100
R32 100
R25 1M
R30 1M
D2 AZ23C5V6
R28 220K
R29 220K
C22 0.1uF
D1 BAS16
Q4 NDS331N
D4 BAT54C
R35 220K
JP1
7A F1
C13 1.0uF
R16 100K
C25 2.2uF
R20 10K
8.45K R34
8.45K R26
RT2 10K
RT1 10K
C26 0.47uF
C21 0.47uF
R33 61.9K
R27 61.9K
RTX2 X4
RTX1 X3
RTX2 X2
RTX1 X1
C24 0.1uF
C23 0.1uF
R13 5.1K
R15 5.1K
R18 5.1K
R11 3M
R19 3M
Q1 FDS6690A
Q3 FDS6690A
R14 1M
Q2 Si4435DY
R12 301 1W
Q5 BSS138
C11 0.1uF
C14 0.1uF
Place C19 close to U3
D4 and Q5 provide protection during a reverse charge event.
Texas Instruments
Title bq20Z70/bq29330/bq29412 4−Cell Ref Design
Size C
Number {Drawing Number}
Rev A
Date Thu Jun 01, 2006
Drawn by Simon Wen
Filename z70_4Cell_Ref.sch
Sheet 1 of 1

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
BQ20Z70PW-V160	ACTIVE	TSSOP	PW	20	70	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	20Z70	Samples
BQ20Z70PWR-V150	ACTIVE	TSSOP	PW	20	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	20Z70	Samples
BQ20Z70PWR-V160	ACTIVE	TSSOP	PW	20	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	20Z70	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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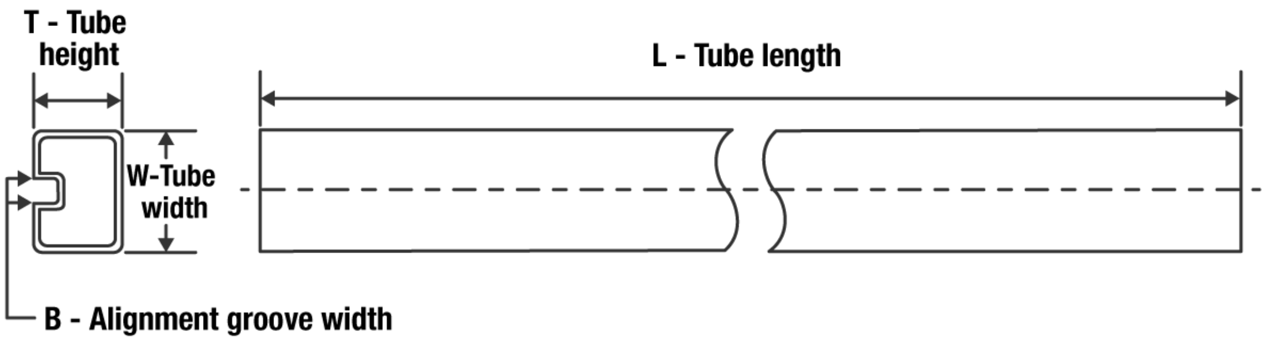
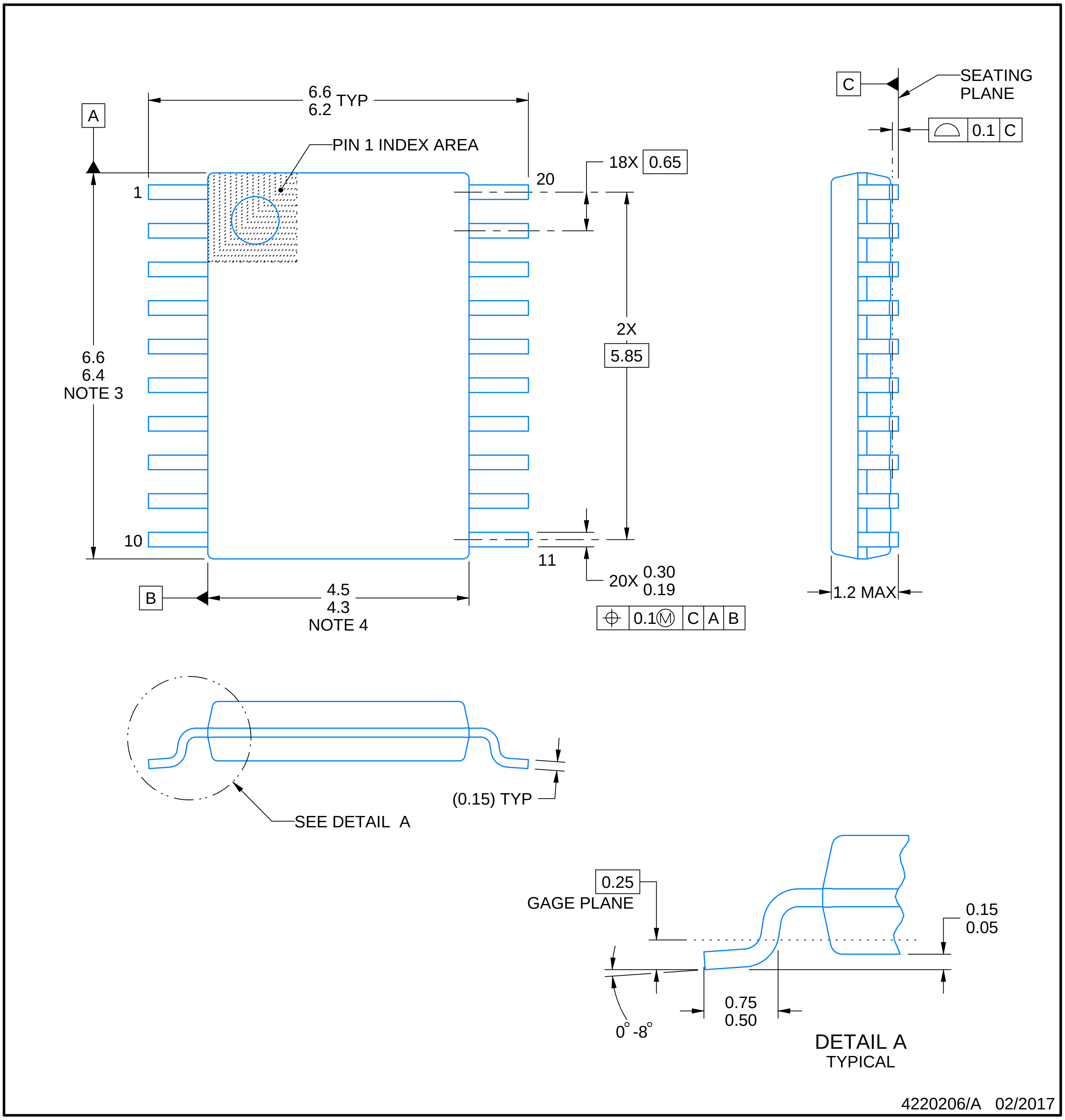
TUBE



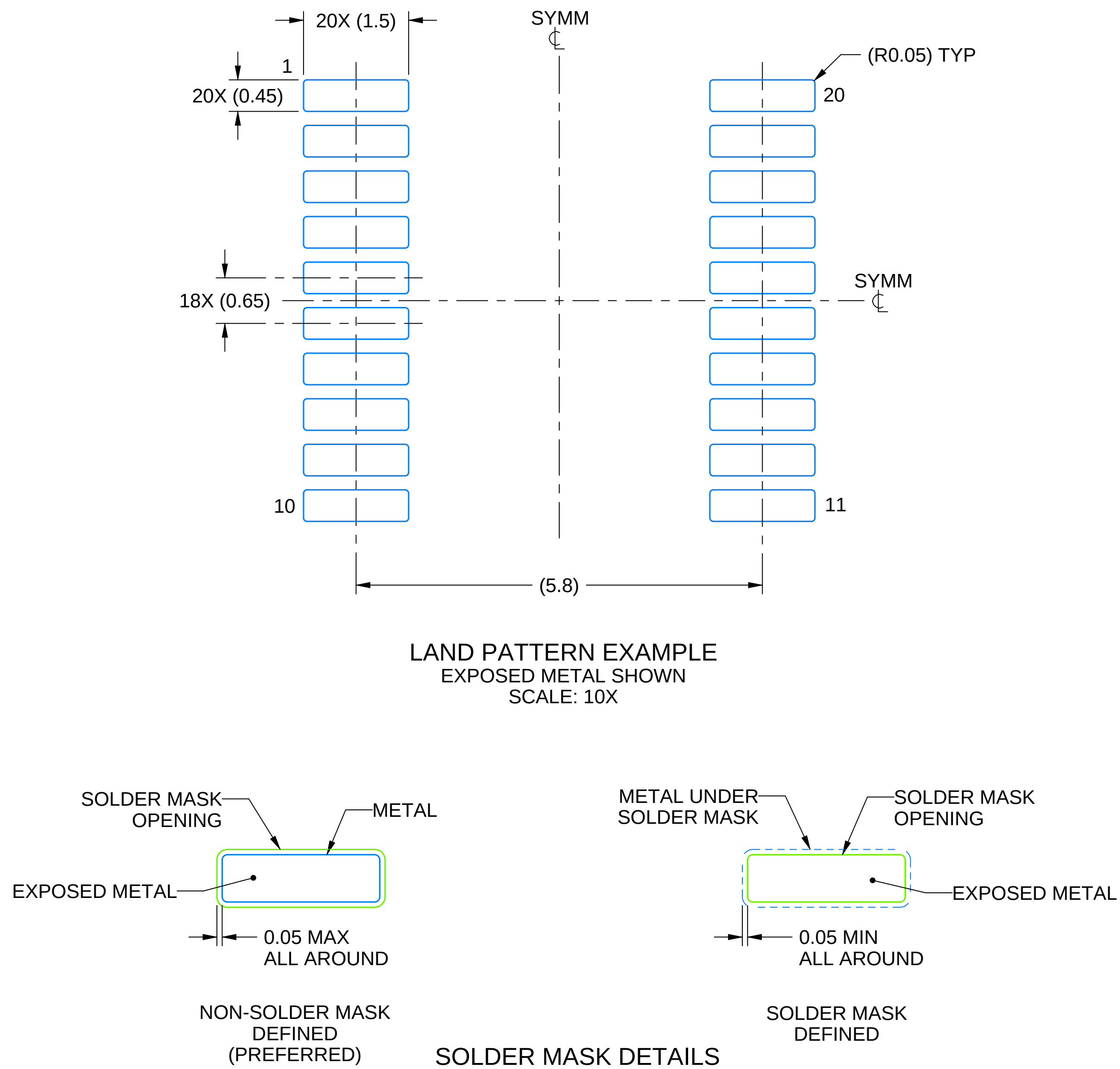
*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
BQ20Z70PW-V160	PW	TSSOP	20	70	530	10.2	3600	3.5



NOTES:

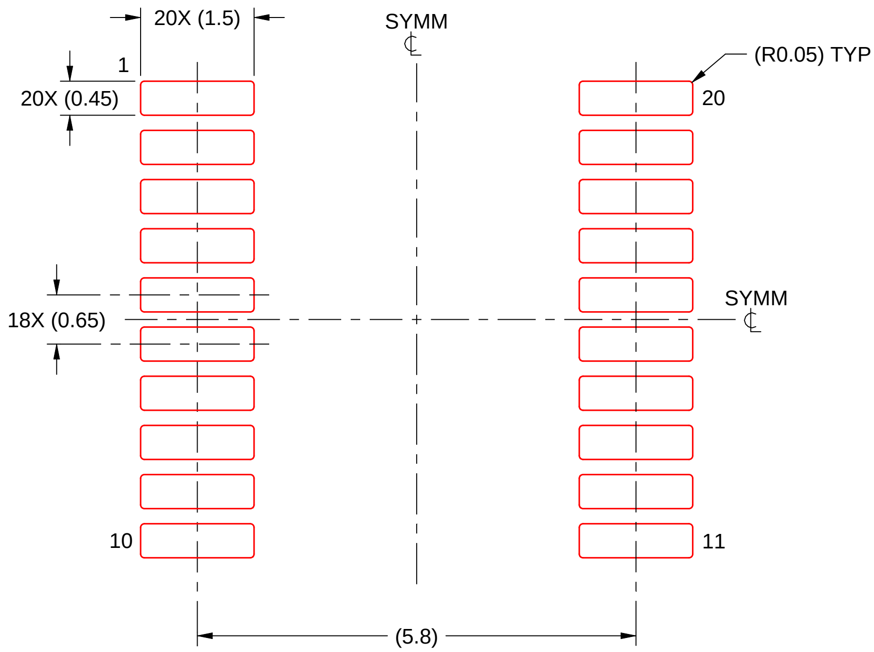
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153.



4220206/A 02/2017

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



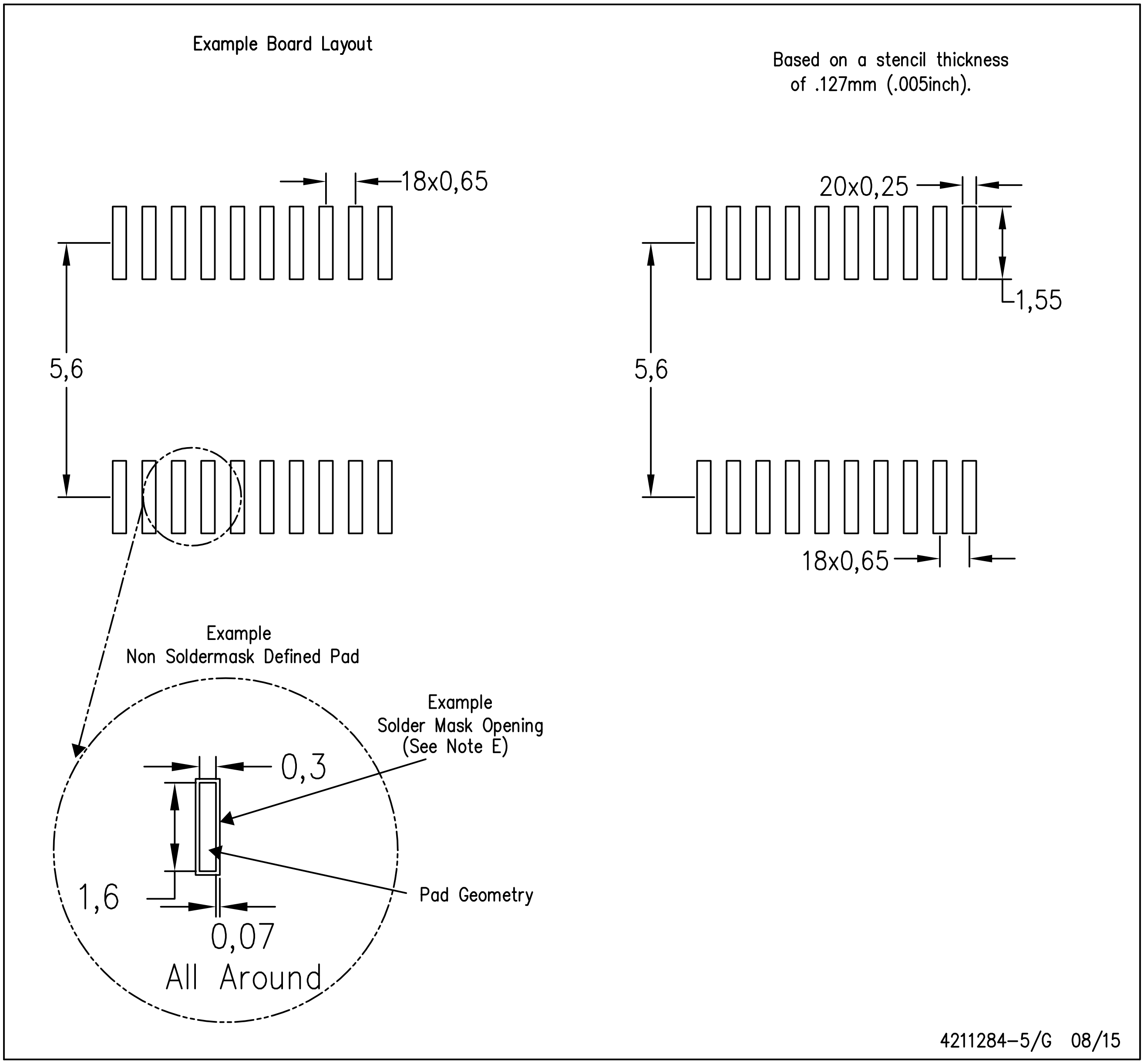
SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 10X

4220206/A 02/2017

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

PW (R-PDSO-G20) PLASTIC SMALL OUTLINE



NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC-7351 is recommended for alternate design.
D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

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