

bq25120 Evaluation Module

The bq25120 evaluation module (EVM) on PWR731 PCB is a high-performance, easy-to-use development kit for the design of a compact, flexible, high-efficiency, lower power management solution for single-cell, Li-ion and Li-polymer batteries used in wearables and low-power portable applications.

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1 Introduction

1.1 bq25120 IC Features

The bq25120 is a highly-integrated battery charge management IC that integrates the most common functions for wearable devices: linear charger, regulated output, load switch, manual reset with timer, and battery voltage monitor. The low quiescent current during operation and shutdown enables maximum battery life. The device supports charge currents from 5 mA to 300 mA. The input current limit, charge current, PWM output voltage, LDO output voltage, and other parameters are programmable through the I²C interface. The battery is charged using a standard Li-Ion charge profile with three phases: precharge, constant current, and constant voltage.

1.2 bq25120 EVM-731 Features

The bq25120 EVM on PWR731 PCB is a complete battery power management module for evaluating compact, highly-integrated, flexible, high efficiency, linear charging solution for single cell, Li-Ion and Li-Polymer battery-powered systems used in wearables and low-power portable applications. Key EVM features include:

- Configurable 300-mA buck regulator (1.8-V default)
- 700-nA typical I_Q with PWM enabled
- 0.5% accurate battery voltage regulation (configurable from 3.6 V to 4.65 V in 10-mV steps)
- Configurable termination current down to 500 μ A
- 2.5 mm \times 2.5 mm WCSP package and 6 external components for minimum solution
- Power path management for powering the system and charging the battery
- Power path management enables < 150 nA ship mode battery quiescent current for longest shelf life
- Push-button wake-up and reset with adjustable timers
- Battery charger operates from 3.4 V – 5.5 V V_{IN} (5.5-V OVP / 20-V tolerant)
- I²C control of key parameters

1.3 Schematic

Figure 1 illustrates the EVM schematic.

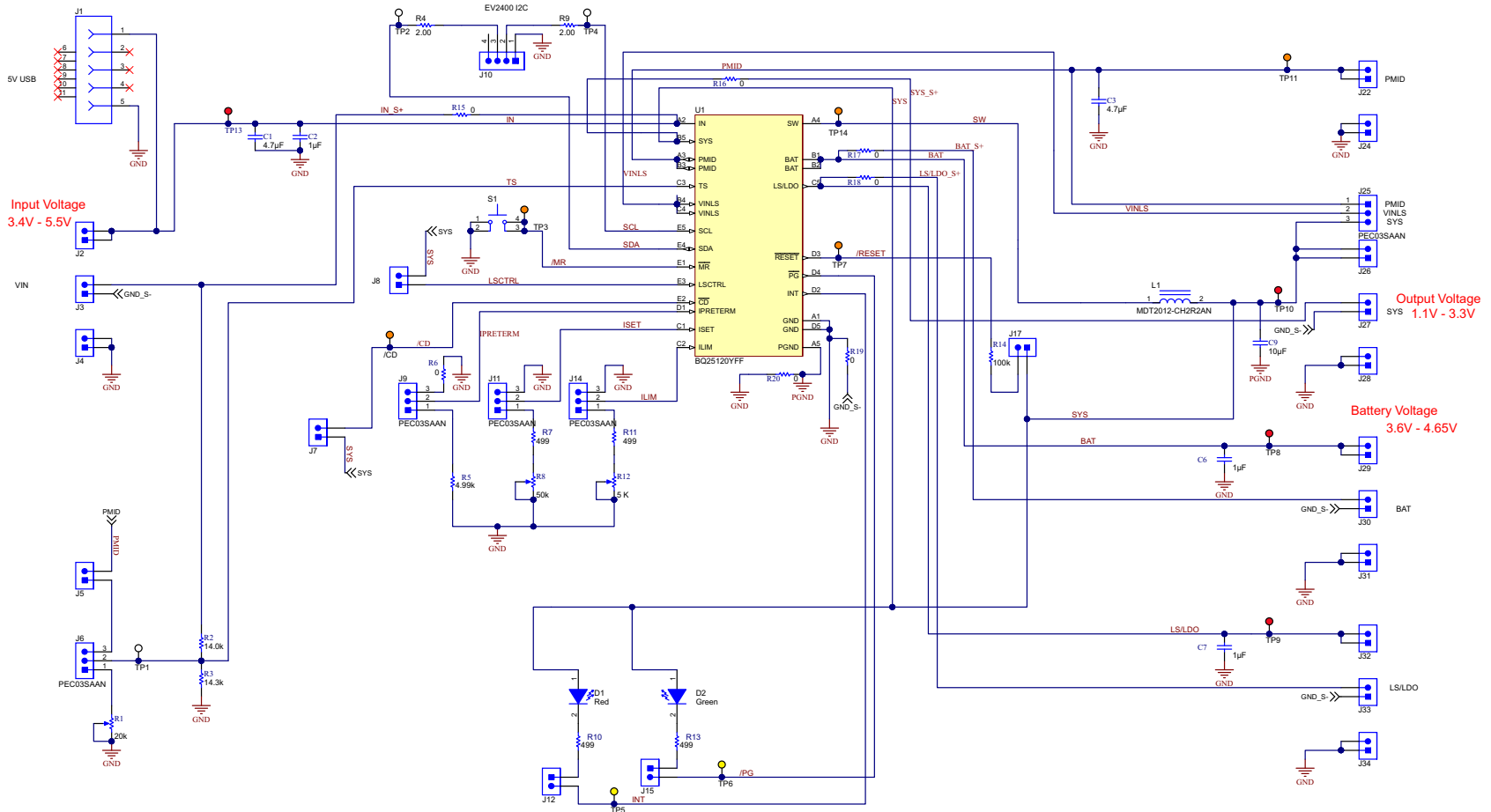


Figure 1. bq25120EVM (PWR731) Schematic

1.4 I/O Description

Table 1 lists the descriptions of the IO connectors on the PCB.

Table 1. Description of the IO Connectors on PCB

Header or Terminal Block	Description
J1 - USB power input	Micro USB connector for USB input power
J2 - IN (Force line)	Headers for extra connections to IN-Force
J3 - IN/GND (Sense line)	Headers for IN-Sense and GND
J4 - GND	Headers for extra connections to GND
J5 - TS to PMID	Headers for TS pin to be pulled up to PMID
J6 - TS	Headers for TS pin to be connected either to PMID or external resistor
J7 - CD	Headers for /CD pin to be pulled up to SYS pin
J8 - LS/CTRL	Headers for LS/CTRL pin to be pulled up to SYS pin
J9 - IPRETERM	Headers for IPRETERM pin to be connected to an external resistor or shorted to GND
J10 - EV2400	The 4-wire connector for EV2400 communication interface
J11 - ISET	Headers for ISET pin to be connected to an external resistor or shorted to GND
J12 - INT	Headers for INT pin to be pulled up to SYS pin through a LED light
J14 - ILIM	Headers for ILIM pin to be connected to an external resistor or shorted to GND
J15 - /PG	Headers for /PG pin to be pulled up to SYS pin through a LED light
J17 - /RESET	Headers for /RESET pin to be pulled up to SYS pin through a 100-kΩ resistor
J22 - PMID	Headers for extra connections to PMID
J24 - GND	Headers for extra connections to GND
J25 - PMID/VINLS/SYS	Headers for PMID/VINLS/SYS connections
J26 - SYS	Headers for extra connections to SYS-Force
J27 - SYS/GND (Sense line)	Headers for SYS-Sense and GND
J28 - GND	Headers for extra connections to GND
J29 - BAT	Headers for extra connections to BAT-Force
J30 - BAT/GND (Sense line)	Headers for BAT-Sense and GND
J31 - GND	Headers for extra connections to GND
J32 - LS/LDO	Headers for extra connections to LS/LDO-Force
J33 - LS/LDO (Sense line)	Headers for LS/LDO-Sense and GND
J34 - GND	Headers for extra connections to GND

1.5 Test Points

Table 2 provides descriptions of the test points.

Table 2. Test Points Description

Test Points	Description
TP1	TS pin
TP2	SDA pin
TP3	/MR pin
TP4	SCL pin
TP5	INT pin
TP6	/PG pin
TP7	/RESET pin
TP8	BAT pin
TP9	LS/LDO pin
TP10	SYS pin
TP11	PMID pin
TP13	IN pin
TP14	SW pin
TP /CD	/CD pin

1.6 Default Settings

The bq25120EVM-731 module has provided the capability of changing key parameters using I²C and the EV2400 communication interface. However, I²C communication is not required for this device to operate. The module is programmed to the default settings as is described in Table 3, Table 4 shows the initial jumper positions on the PCB.

Table 3. Default Settings

Parameter	Options	BQ25120
BAT_UVLO	2.2 V to 3.4 V (200-mV step)	3.0 V
VSYS	1.1 V to 3.3 V (100-mV step)	1.8 V
LS/LDO	LS, 0.8 V to 3.3 V (100-mV step)	LS
VBREG	3.6 V to 4.65 V (10-mV step)	4.2 V
ICHG	5 mA to 300 mA	10 mA
IPRETERM	500 μ A to 50 mA	2 mA
Input ILIM	50 mA to 400 mA (50-mA step)	100 mA
VIN_DPM_ON	On or Off	On
VIN_DPM Threshold	4.2 V to 4.9 V	4.6 V
Auto Charge	On or Off	On
Safety Timer	30 min, 3 hr, 9 hr, Disabled	3 hr

Table 4. Initial Jumper Position

J6	J9	J11	J12	J14	J15	J25
TS = TS_Pot	ITERM = GND	ISET= GND	Installed	ILIM = GND	Installed	VINLS = PMID

1.7 Recommended Operating Conditions

The recommended operating conditions are shown in Table 5.

Table 5. Recommended Operating Conditions⁽¹⁾⁽²⁾

		MIN	NOM	MAX	Unit
V _{IN}	IN voltage range	3.4	5	20	V
	IN operating voltage range, recommended	3.4	5	5.5	
V _{BAT}	VBAT operating voltage range			5.5(1)	V
V _{VINLS}	VINLS voltage range for Load Switch	0.8		5.5(2)	V
V _{VINLS}	VINLS voltage range for LDO	2.2		5.5	V
I _{IN}	Input Current, IN input			400	mA
I _{SW}	Output Current from SW, DC			300	mA
I _{PMID}	Output Current from PMID, DC			300	mA
I _{LS/LDO}	Output Current from LS/LDO			100	mA
I _{BAT} , I _{SYS}	Charging and discharging using internal battery FET			300	mA
T _J	Operating junction temperature range	-40		125	°C

⁽¹⁾ Any voltage greater than shown should be a transient event.

⁽²⁾ These inputs will support 6.6 V for less than 10% of the lifetime at V_(BAT) or V_{IN}, with a reduced current and/or performance.

2 Test Summary

This section describes the test configuration of the bq25120EVM-731 evaluation module for bench evaluation.

2.1 Recommended Test Equipment

2.1.1 Power Supplies

1. Power Supply #1 (PS#1): a power supply capable of supplying 5 V at 1 A is required.
2. Power Supply #2 (PS#2): a power supply capable of supplying 5 V at 1 A is required.

2.1.2 Load

Testing with an actual battery is the best way to verify operation in the system. If a battery is unavailable, then a source meter like a Keithley 2420, capable of both sourcing and sinking current, or a circuit similar to the one shown in Figure 2 can simulate a battery when connected to PS#2.

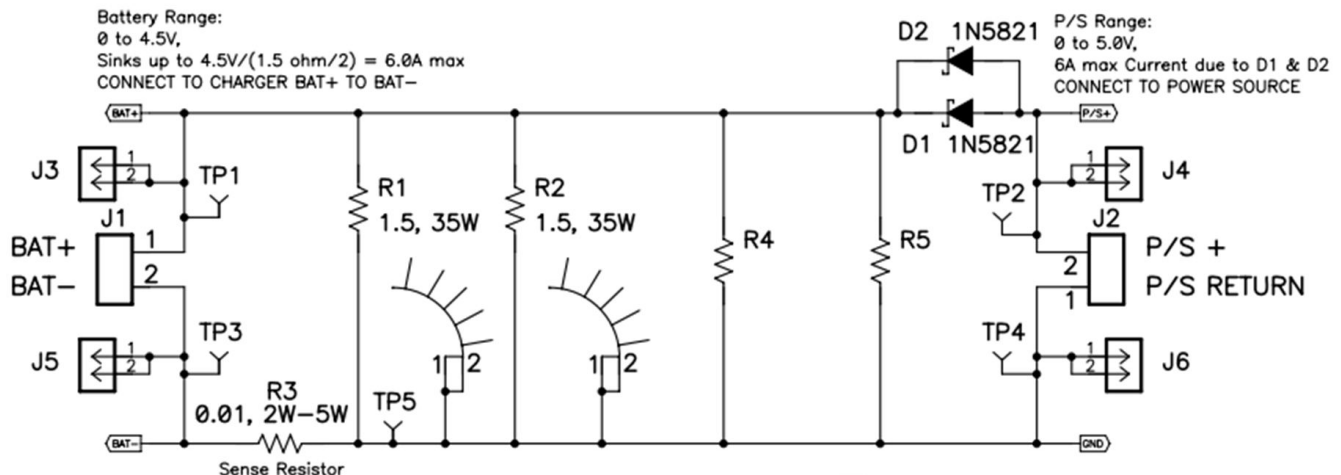


Figure 2. BAT Load (PR1010) Schematic

2.1.3 Meters

Three voltage meters and two current meters. The current meters must be able to measure at least 0.5-A current.

2.1.4 Tool/Software GUI (Optional)

The following optional items can be used for testing:

1. [EV2400](#) Communication Interface Board
2. [bqStudio](#) Software GUI

2.2 Recommended Test Equipment Setup

The following guidelines provide the recommended test equipment setup:

1. Set power supply #1 (PS#1) for 5 V \pm 100 mV DC, 1-A current limit and then turn off supply. Set power supply #2 (PS#2) for 3.5 V and then turn off supply.
2. Connect the positive output of PS#1 through a current meter (CM#2) to IN (J2) and negative output to GND (J34).
3. Connect a voltage meter (VM#1) across J2 and J34.
4. Connect the PR1010 BAT+ terminal of PR1010 in series with a current meter (CM#1) to BAT (J29). Connect PR1010 BAT – to GND (J34). Connect the P/S+ and P/S return side of PR1010 to PS#2, set the voltage to 3.5 V \pm 50 mV, then disable PS#2.
5. Connect a voltage meter (VM#2) across BAT (J29) and GND (J34).
6. Connect a DMM (VM#3) across SYS (SYS_S+ of J27) and GND (GND_S– of J27).
7. Configure jumpers as shown in [Table 4](#).

After the preceding steps are accomplished, the test setup for PWR731 is as shown in [Figure 3](#).

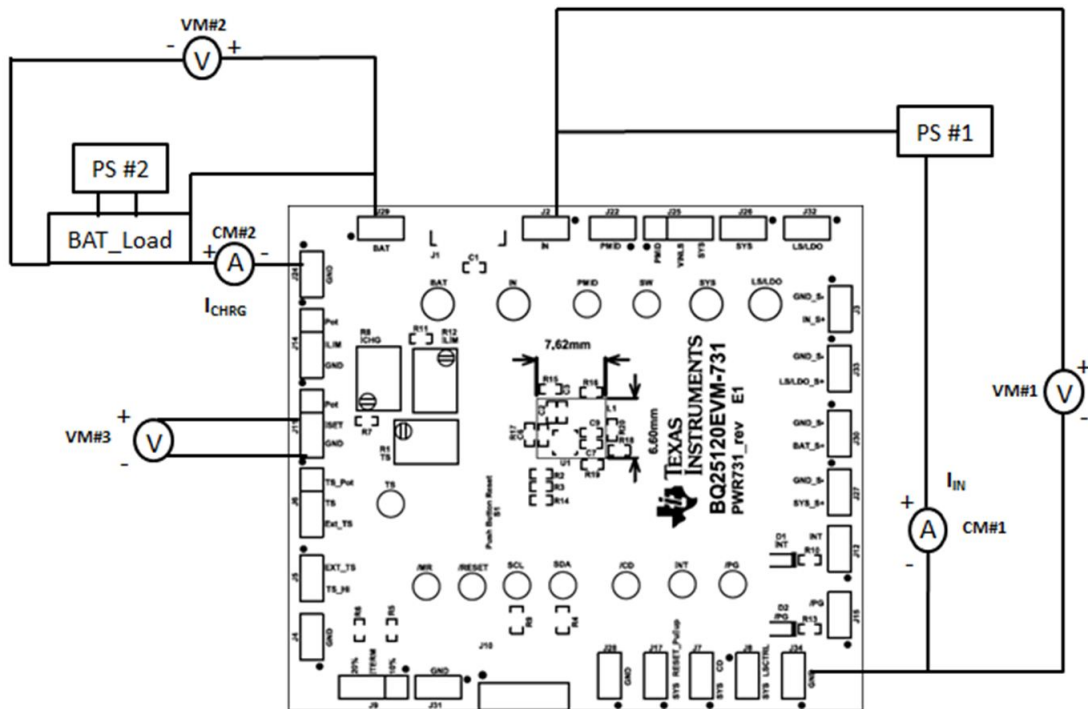


Figure 3. Test Setup for PWR731 (bq25120EVM-731)

2.3 Software GUI (When I²C Communication is Used)

When using I²C communication, implement the following steps with the software GUI:

1. Install the [bqStudio](#) software GUI.
2. Connect the EV2400 interface board to the EVM (as shown in [Figure 4](#)) <http://www.ti.com/tool/EV2400>.
3. Open Software GUI and go to “Field View” page (as shown in [Figure 5](#)).
4. Change the parameters in the pull-down menu or check/uncheck the selection box.

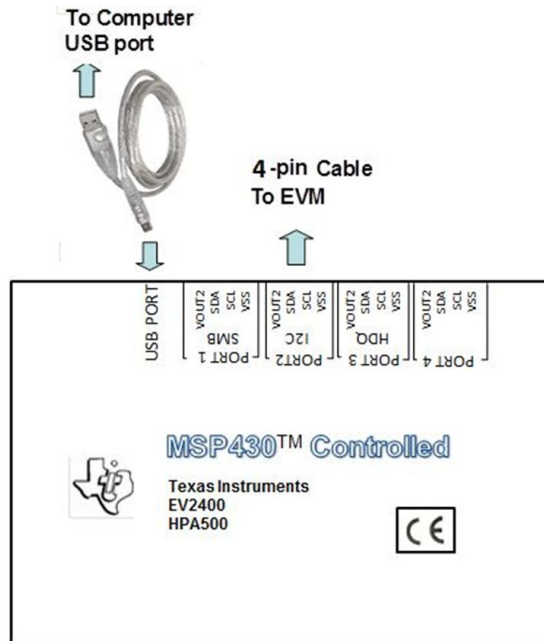


Figure 4. EV2400 Interface Box Connection

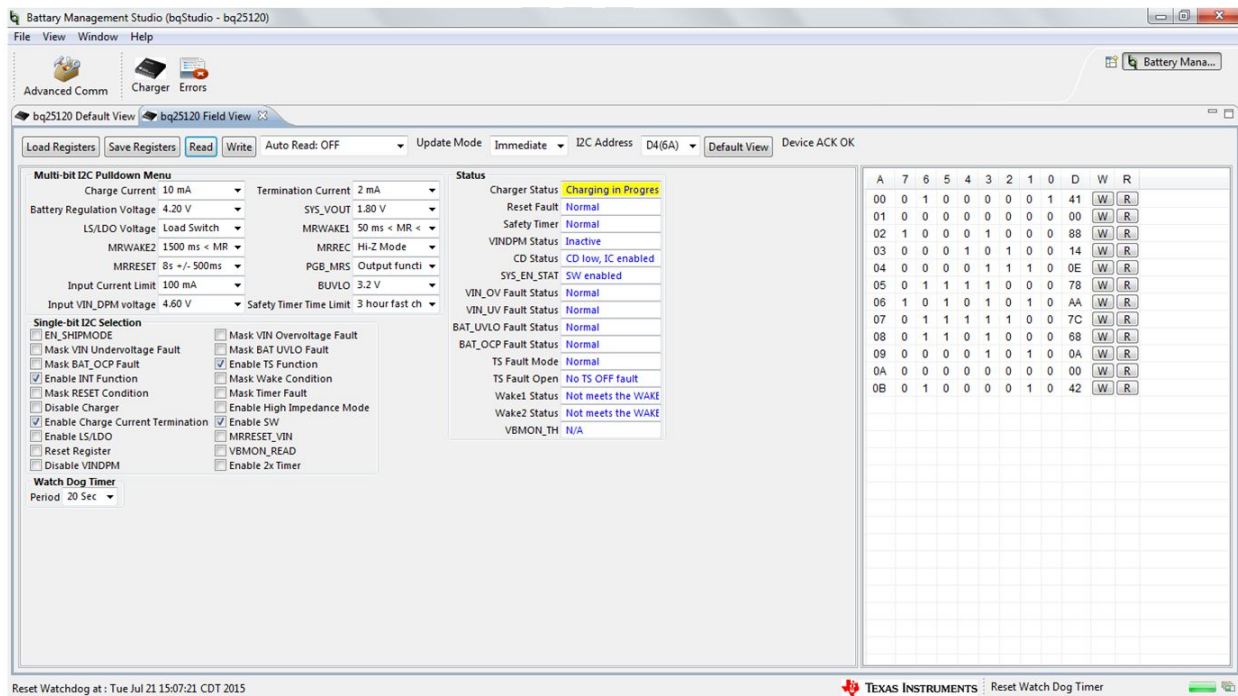


Figure 5. bq25120 Software GUI

3 Test Procedure

3.1 Set the Potentiometers

1. Set VM#3 DMM to measure resistance
2. Install J11 to POT
3. Install J14 to POT
4. Turn the potentiometer R8 until the measure on VM#3 → $R[J11 (ISET), J11(GND)] = 2 \text{ k}\Omega$.
5. Move the positive side of VM#3 DMM to J14 (ILIM).
6. Turn the potentiometer R12 until the measure on VM#3 → $R[J14(ILIM), J14(GND)] = 499 \Omega$.
7. Move the positive side of VM#3 DMM to J6 (TS).
8. Turn the potentiometer R1 until the measure on VM#3 → $R[J6 (TS), J14(GND)] = 5.5 \text{ k}\Omega - 6.5 \text{ k}\Omega$.
9. Move the positive side of VM#3 DMM to J27 (SYS_S+).
10. Set VM#3 DMM to measure voltage.

3.2 Charge Disabled

1. Install the jumper on J7 – connect CD to SYS
2. Enable PS#1 and PS#2
3. Observe D2 is on, D1 is off
4. Measure on VM#3 → $V[J27(SYS_S+) J14(GND)] = 1.8V \pm 50 \text{ mV}$
5. Measure on CM#2 → $ICHRG \leq 0-1 \text{ mA}$
6. Measure on CM#1 → $IIN < 2 \text{ mA}$
7. Disable PS#1 and PS#2

3.3 Charge Current Regulation

1. Remove the jumper on J7 – disconnect CD to SYS
2. Enable PS#1 and PS#2
3. Observe D2 is on, D1 is on
4. Adjust PS#2 so that the voltage measured by VM#2, across BAT and GND, measures 3.5 V
5. Adjust the PS#1 so that VM#1 still reads $5.0 \text{ V} \pm 100 \text{ mV}$
6. Measure on VM#3 → $V[J27(SYS_S+) J14(GND)] = 1.8 \text{ V} \pm 50 \text{ mV}$
7. Measure on CM#2 → $ICHRG = 90-110 \text{ mA}$
8. Measure on CM#1 → $IIN = 93-113 \text{ mA}$
9. Disable PS#1 and PS#2

3.4 Ship Mode (Optional if FC Control not Used)

1. Enable PS#1 and PS#2
2. Open the software GUI
3. Go to Field View of the GUI and then read all the registers. All the default register values should be shown in the register map (as shown in [Figure 3](#)).
4. Measure on CM#2 → $ICHRG = 9-11 \text{ mA}$
5. Install the jumper on J7 – connect CD to SYS
6. Disable PS#1
7. Measure on CM#2 → $ICHRG = 5-7 \mu\text{A}$
8. Check the box in front of “EN_SHIPMODE” in the software GUI

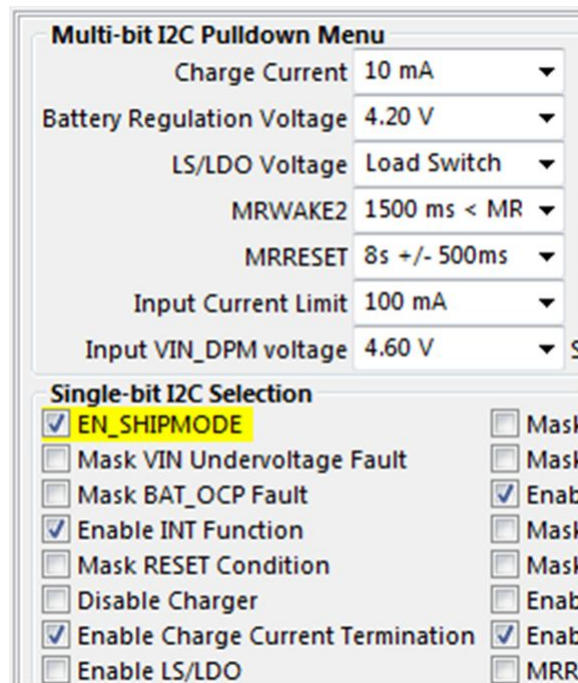


Figure 6. Select EN_SHIPMODE

9. Measure on CM#2 → ICHRG < 100 nA
10. Disable PS#2

4 Helpful Hints

The following steps provide useful information when using the EVM:

1. The leads and cables to the various power supplies have resistance. The current meters also have series resistance. Therefore, voltmeters must be used to measure the voltage as close to the IC pins as possible instead of relying on each supply's digital measurement.
2. When using a source meter as your battery simulator, it is highly recommended to configure the source meter for 4-wire sensing, eliminating the need for a separate voltmeter to measure the voltage at the OUT pin.
3. To observe the taper current as the battery voltage approaches the set regulation voltage, allow the battery to charge, or if using BAT_Load (PR1010), slowly increase the PS#2 voltage powering BAT_Load (PR1010). Use VM#2 across OUT and GND to measure the battery voltage seen by the IC.
4. To find out more details about battery I_Q and how to measure it on power supplies, please refer to the application note: *IQ: What it is, what it isn't, and how to use it* ([SLYT412](#))

5 Bill of Materials and Board Layout

This section provides the bq25120 EVM bill of materials (BOM) and the printed-circuit board (PCB) layout illustrations.

5.1 Bill of Materials

Table 6 lists the EVM BOM.

Table 6. bq25120EVM Bill of Materials ⁽¹⁾

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
IPCB	1		Printed Circuit Board		PWR731	Any	-	-
/CD, TP3, TP7, TP11, TP14	5	Orange	Test Point, Miniature, Orange, TH	Orange Miniature Testpoint	5003	Keystone		
C1, C3	2	4.7uF	CAP, CERM, 4.7 μ F, 16 V, +/- 20%, X5R, 0402	0402	GRM155R61C475ME11D	Murata		
C2	1	1uF	CAP, CERM, 1 μ F, 25 V, +/- 10%, X5R, 0402	0402	C1005X5R1E105K050BC	TDK		
C6, C7	2	1uF	CAP, CERM, 1 μ F, 10 V, +/- 10%, X5R, 0402	0402	GRM155R61A105KE15D	Murata		
C9	1	10uF	CAP, CERM, 10 μ F, 10 V, +/- 20%, X5R, 0402	0402	CL05A106MP5NUNC	Samsung Electro-Mechanics		
D1	1	Red	LED, Red, SMD	Red LED, 1.6x0.8x0.8mm	LTST-C190CKT	Lite-On		
D2	1	Green	LED, Green, SMD	1.6x0.8x0.8mm	LTST-C190GKT	Lite-On		
FID4, FID5, FID6	3		Fiducial mark. There is nothing to buy or mount.	Fiducial	N/A	N/A		
H12, H13, H14, H15	4		Bumpon, Cylindrical, 0.312 X 0.200, Black	Black Bumpon	SJ61A1	3M		
J1	1		Receptacle, Micro-USB-B, Right Angle, SMD	Micro USB receptacle	105017-0001	Molex		
J2, J3, J4, J5, J7, J8, J12, J15, J17, J22, J24, J26, J27, J28, J29, J30, J31, J32, J33, J34	20		Header, 100mil, 2x1, Tin plated, TH	Header, 2 PIN, 100mil, Tin	PEC02SAAN	Sullins Connector Solutions		
J6, J9, J11, J14, J25	5		Header, 100mil, 3x1, Tin, TH	Header, 3 PIN, 100mil, Tin	PEC03SAAN	Sullins Connector Solutions		
J10	1		Header (friction lock), 100mil, 4x1, R/A, TH	4x1 R/A Header	22-05-3041	Molex		
L1	1	2.2 uH	Inductor, SMT, 600mA, 245-milliohm, 2.2uH	2012	MDT2012-CH2R2AN	TOKO		
R1	1	20k	Trimmer, 20k ohm, 0.25W, TH	4.5x8x6.7mm	3266W-1-203LF	Bourns		
R2	1	14.0k	RES, 14.0k ohm, 1%, 0.063W, 0402	0402	CRCW040214K0FKED	Vishay-Dale		
R3	1	14.3k	RES, 14.3k ohm, 1%, 0.063W, 0402	0402	CRCW040214K3FKED	Vishay-Dale		
R4, R9	2	2.00	RES, 2.00 ohm, 1%, 0.1W, 0603	0603	CRCW06032R00FKEA	Vishay-Dale		
R5	1	4.99k	RES, 4.99 k, 1%, 0.063 W, 0402	0402	CRCW04024K99FKED	Vishay-Dale		
R6, R15, R16, R17, R18, R19, R20	7	0	RES, 0, 5%, 0.063 W, 0402	0402	CRCW04020000Z0ED	Vishay-Dale		
R7, R10, R11, R13	4	499	RES, 499 ohm, 1%, 0.063W, 0402	0402	CRCW0402499RFKED	Vishay-Dale		
R8	1	50k	Trimmer, 50k ohm, 0.25W, TH	4.5x8x6.7mm	3266W-1-503LF	Bourns		
R12	1	5 K	Trimmer, 5k ohm, 0.25W, TH	4.5x8x6.7mm	3266W-1-502LF	Bourns		
R14	1	100k	RES, 100k ohm, 1%, 0.063W, 0402	0402	CRCW0402100KFKED	Vishay-Dale		
S1	1		Switch, Tactile, SPST-NO, SMT	Switch, 6.2X5X6.2 mm	KST221JLFS	C&K Components		
SH-JP1, SH-JP2, SH-JP3, SH-JP4, SH-JP5	5	1x2	Shunt, 100mil, Gold plated, Black	Shunt	969102-0000-DA	3M	SNT-100-BK-G	Samtec

⁽¹⁾ Unless otherwise noted in the Alternate Part Number and/or Alternate Manufacturer columns, all parts may be substituted with equivalents.

Table 6. bq25120EVM Bill of Materials⁽¹⁾ (continued)

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
TP1, TP2, TP4	3	White	Test Point, Miniature, White, TH	White Miniature Testpoint	5002	Keystone		
TP5, TP6	2	Yellow	Test Point, Miniature, Yellow, TH	Yellow Miniature Testpoint	5004	Keystone		
TP8, TP9, TP10, TP13	4	Red	Test Point, Compact, Red, TH	Red Compact Testpoint	5005	Keystone		
U1	1		YFF0025AWAW	YFF0025AWAW	BQ25120YFF	Texas Instruments		Texas Instruments
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	Fiducial	N/A	N/A		

5.2 Board Layouts

Figure 7 through Figure 16 illustrate the EVM PCB board layouts.

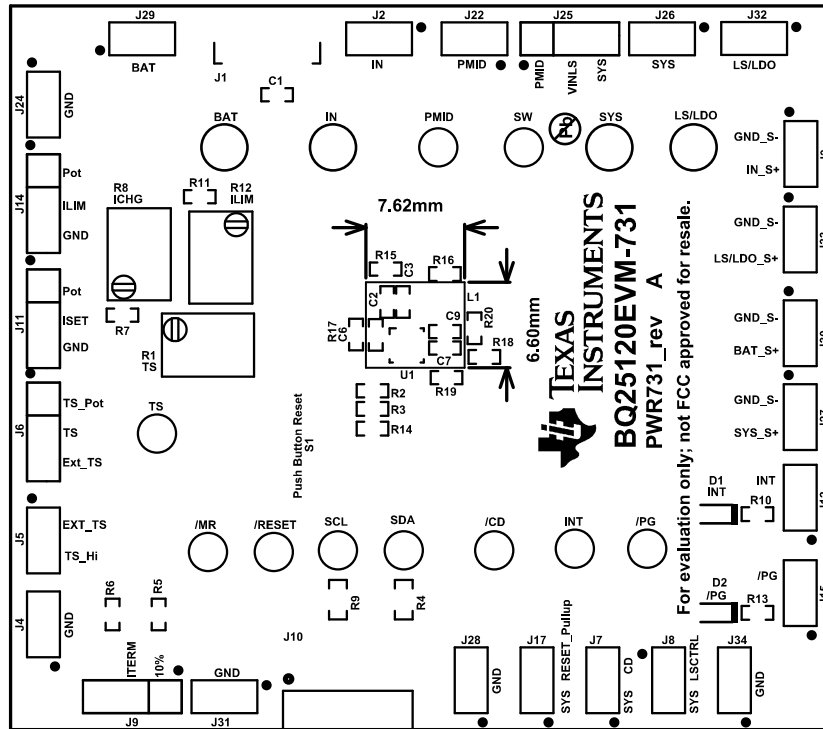


Figure 7. Top Overlay

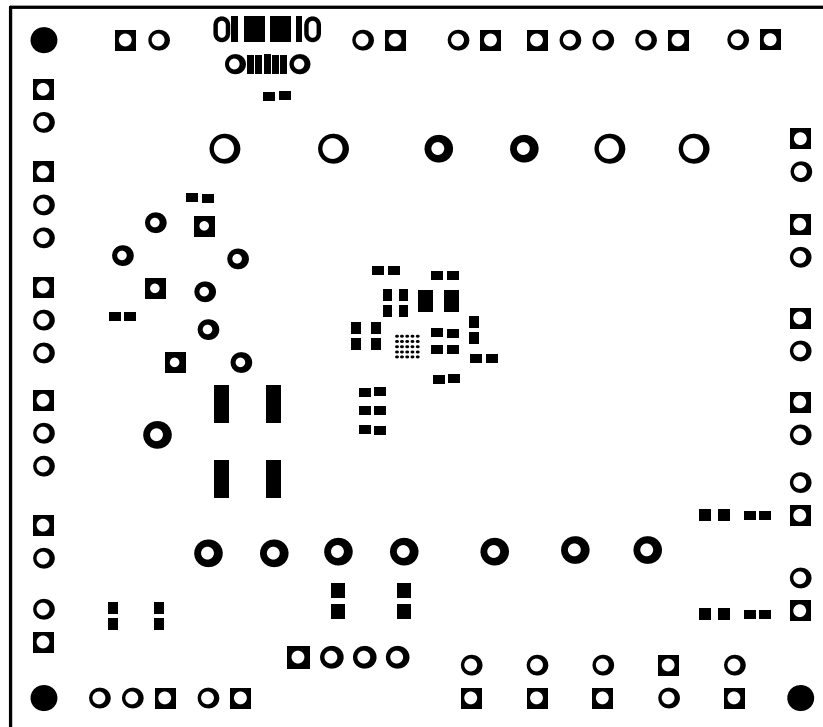


Figure 8. Top Solder Mask

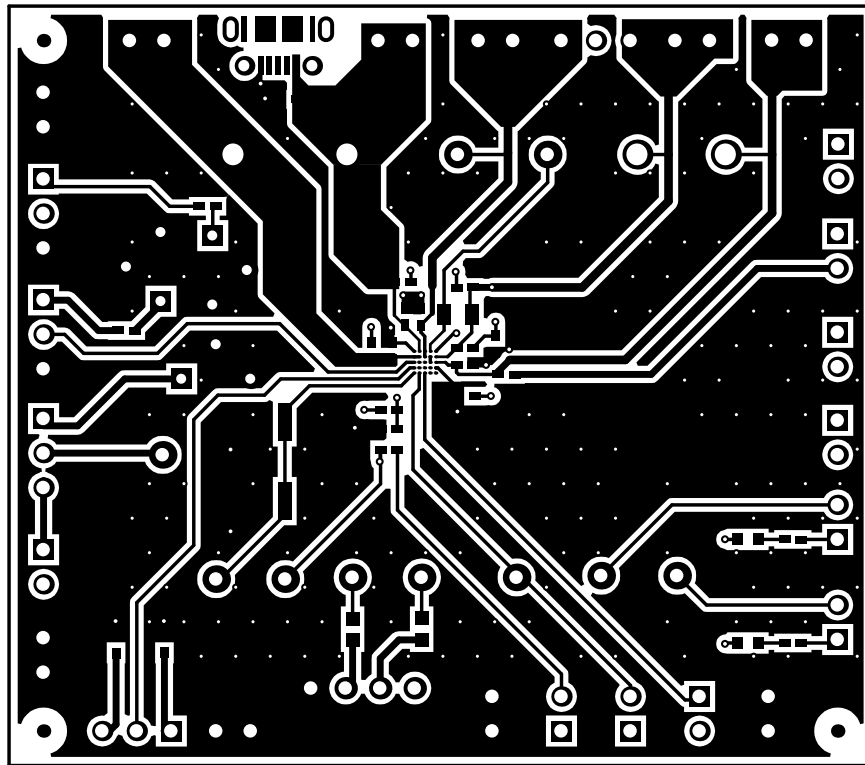


Figure 9. Top Layer

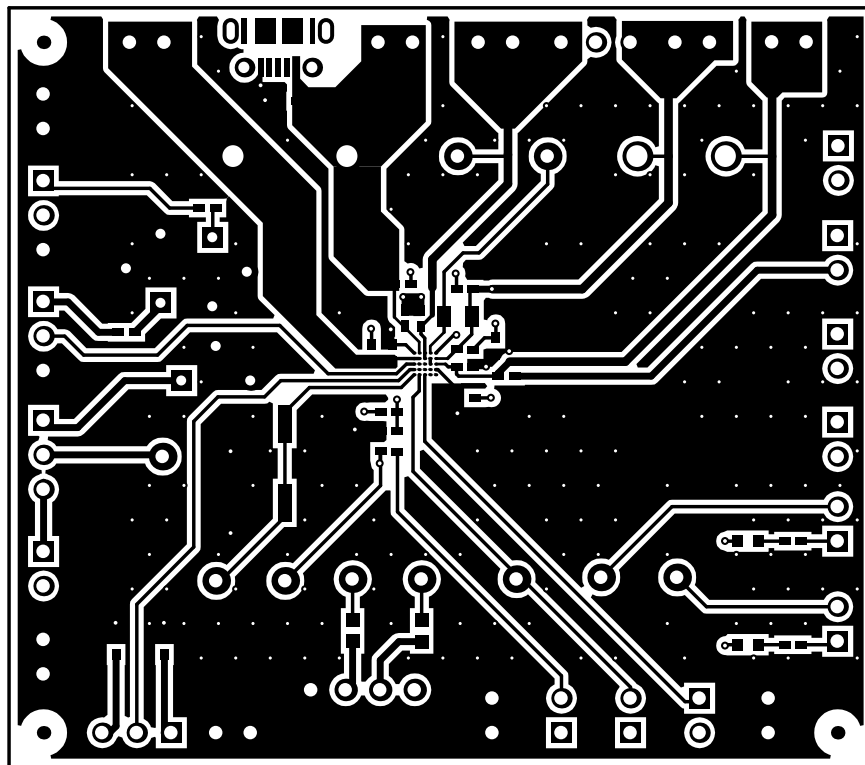


Figure 10. Signal Layer 1

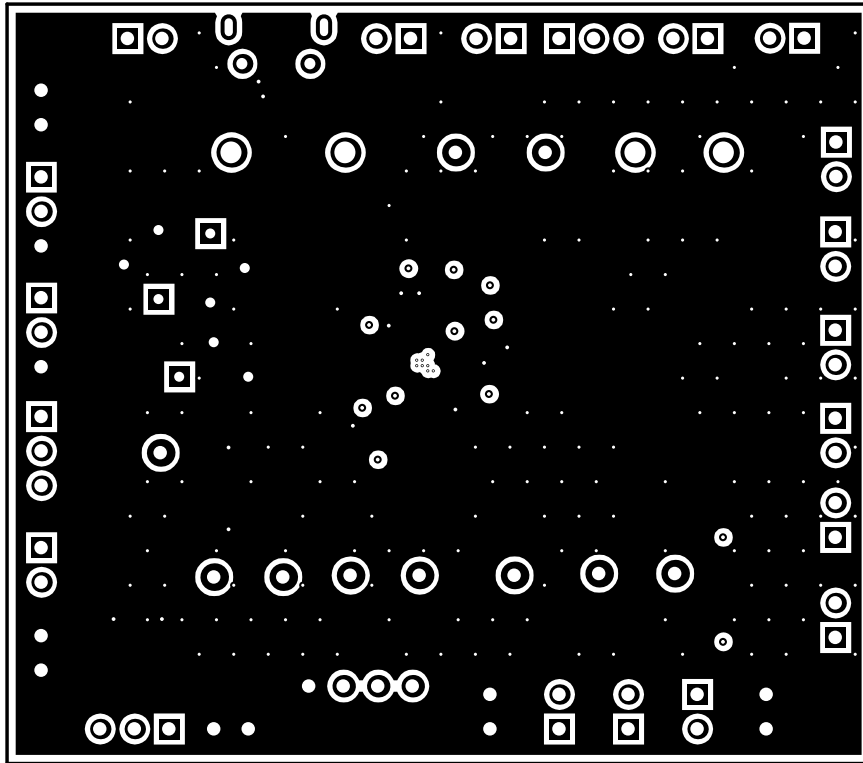


Figure 11. Signal Layer 2

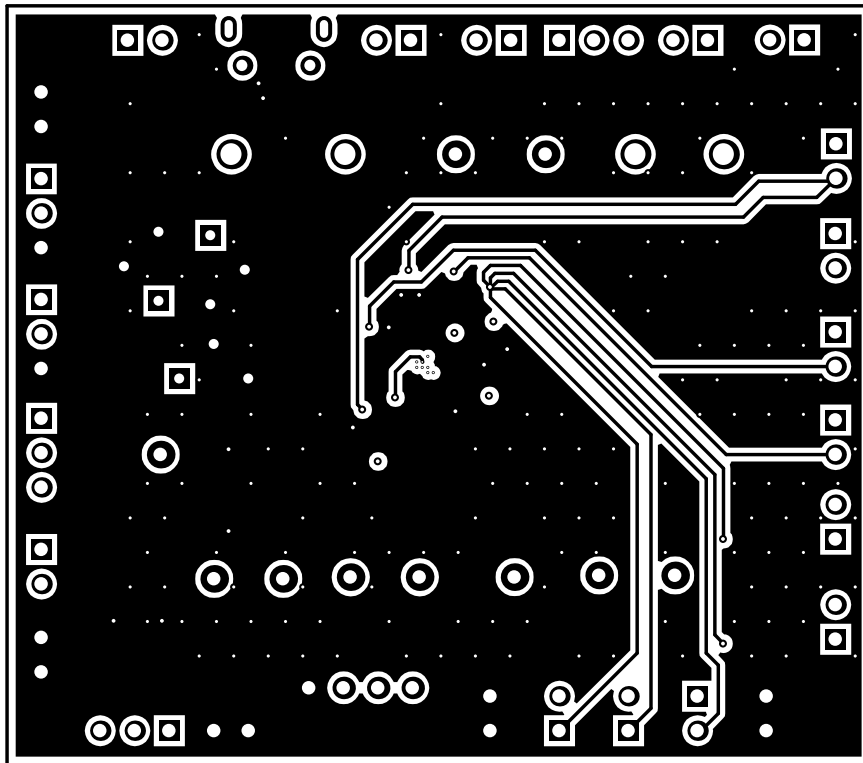


Figure 12. Bottom Layer

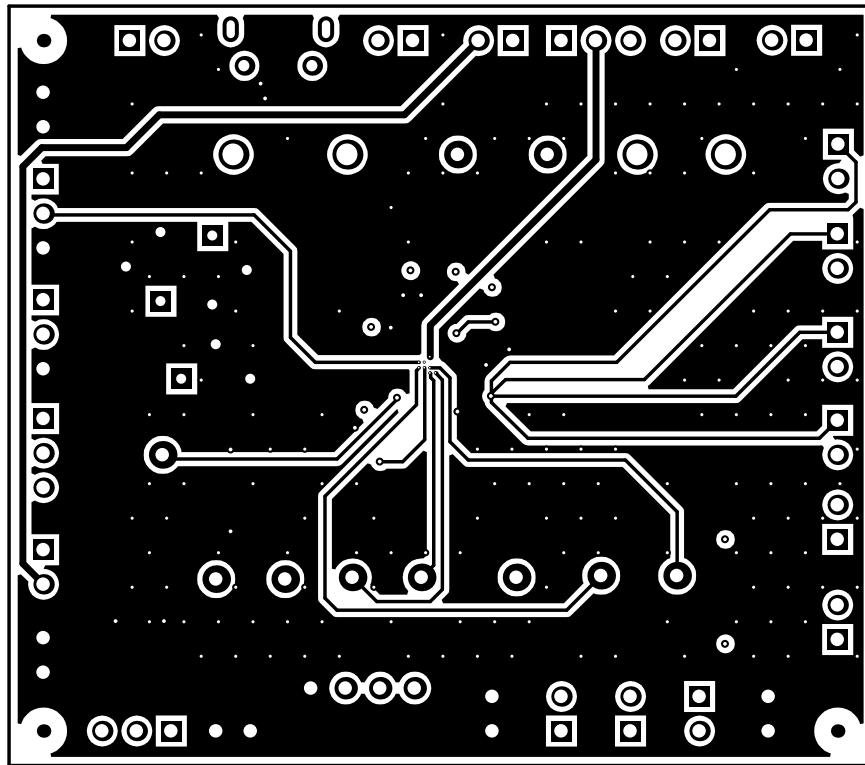


Figure 13. Bottom Solder Mask

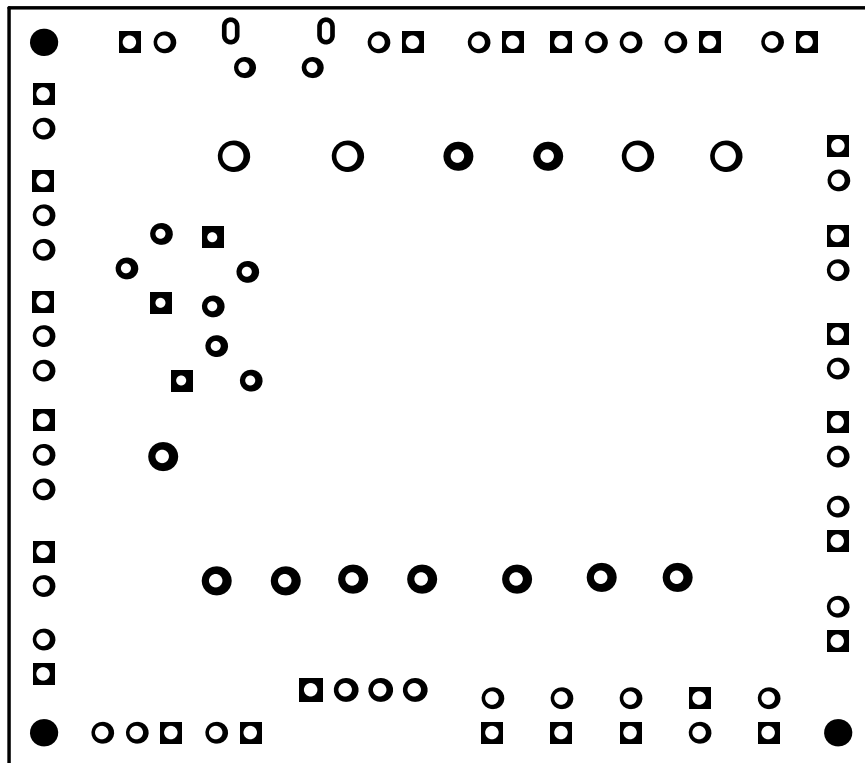


Figure 14. Bottom Overlay

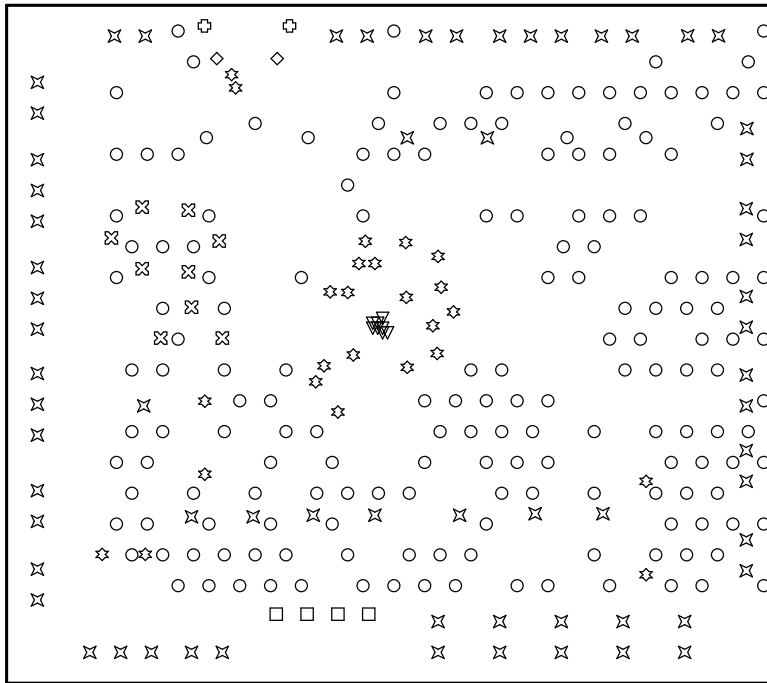


Figure 15. Drill Drawing

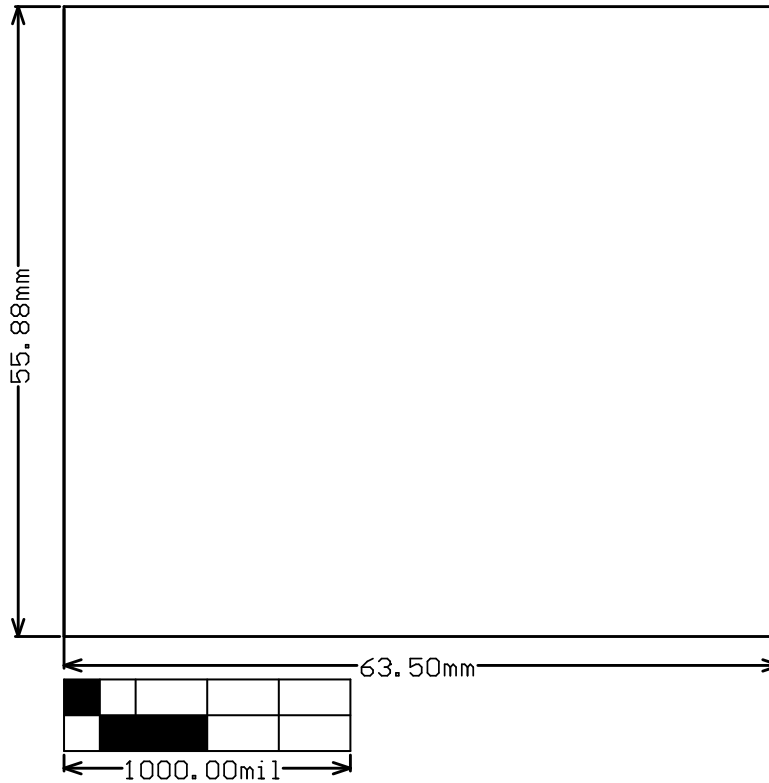


Figure 16. Board Dimensions

STANDARD TERMS AND CONDITIONS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, or documentation (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms and conditions set forth herein. Acceptance of the EVM is expressly subject to the following terms and conditions.
 - 1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM ("Software") shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms and conditions that accompany such Software
 - 1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.
2. *Limited Warranty and Related Remedies/Disclaimers:*
 - 2.1 These terms and conditions do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.
 - 2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for any defects that are caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI. Moreover, TI shall not be liable for any defects that result from User's design, specifications or instructions for such EVMs. Testing and other quality control techniques are used to the extent TI deems necessary or as mandated by government requirements. TI does not test all parameters of each EVM.
 - 2.3 If any EVM fails to conform to the warranty set forth above, TI's sole liability shall be at its option to repair or replace such EVM, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.
3. *Regulatory Notices:*
 - 3.1 *United States*
 - 3.1.1 *Notice applicable to EVMs not FCC-Approved:*

This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.
 - 3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

3.2 Canada

3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

3.3 Japan

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required by Radio Law of Japan to follow the instructions below with respect to EVMs:

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/llds/ti_ja/general/eStore/notice_02.page

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4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

6. *Disclaimers:*
- 6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY WRITTEN DESIGN MATERIALS PROVIDED WITH THE EVM (AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.
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- 8.1 *General Limitations.* IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS AND CONDITIONS OR THE USE OF THE EVMS PROVIDED HEREUNDER, REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN ONE YEAR AFTER THE RELATED CAUSE OF ACTION HAS OCCURRED.
- 8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY WARRANTY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS AND CONDITIONS, OR ANY USE OF ANY TI EVM PROVIDED HEREUNDER, EXCEED THE TOTAL AMOUNT PAID TO TI FOR THE PARTICULAR UNITS SOLD UNDER THESE TERMS AND CONDITIONS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM AGAINST THE PARTICULAR UNITS SOLD TO USER UNDER THESE TERMS AND CONDITIONS SHALL NOT ENLARGE OR EXTEND THIS LIMIT.
9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.
10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

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Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

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