EVM User's Guide: HCXX-BASE-EVM

TPSxHCxx-Q1 Evaluation Module

Description

The HCXX-BASE-EVM helps designers evaluate the operation and performance of the TPS2HC08-Q1, TPS2HC16-Q1, TPS1HC08-Q1, TPS1HC03-Q1, and TPS1HC04-Q1 devices.

The HCXX-BASE-EVM is a hardware evaluation module (EVM) used to evaluate the functionality and performance of the TPSxHCxx high-side switch devices. The evaluation module is fully equipped to test the TPSxHCxx device family to ease the device integration to various power system applications. The approach to this EVM is to have a module (daughtercard) and a base station (motherboard). The first module in this device family and the one featured in the user's guide is the 2HC08-MOD-EVM. The HCXX-BASE-EVM is designed to be used with an attached voltage supply and output load. Some features such as overcurrent, short-to-ground, open-load, and short-to-battery detection are enabled for use on the evaluation module.

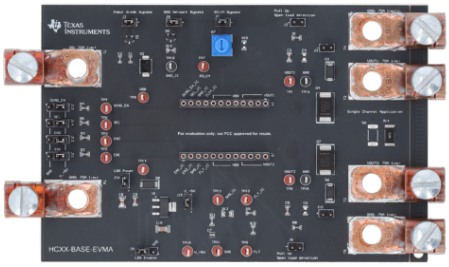
Features

- Operating voltage: 3V–28V
- Ambient operating temperature: –40 to 125°C
- Highly accurate current sense
- Adjustable current limit with external resistor
- OR potentiometer
- Overcurrent, short-to-ground, open-load, and short-to-battery detection
- Onboard LDO allowing for control signal manipulation
- Output jumper to support inductive discharge configurations
- Tested according to AECQ100-12
- Certification of ISO7637-2 and ISO16750-2

Applications

- Multichannel LED Drivers, Bulb Drivers
- Multichannel High-Side Switches for Sub-Modules
- Multichannel High-Side Relay, Solenoid Drivers

2HC08-MOD-EVM



HCXX-BASE-EVM

1 Evaluation Module Overview

1.1 Introduction

Texas Instruments' HCXX-BASE-EVM evaluation module has a central socket for the supporting daughtercard with the high-side switch device. The EVM supports the single-channel and dual-channel low R_{ON} (≤50mΩ) high-side driver applications. The purpose of this EVM is to facilitate evaluation of the low R_{ON} high-side switches for the diagnostic features and drive resistive, capacitive, and inductive loads. The base station has all connectors, jumpers, and test points. The module has footprints to support the low R_{ON} family of TI's high-side switch portfolio.

Each device in the TPSxHCxx high-side switch family has a daughtercard. An additional blank EVM is available for application purposes. The daughtercard orderable part number begins with the channel count and on-resistance to match the device under testing. The layout and schematic for each daughtercard are the same for each EVM. The only change needed to activate the single channel feature on the base station is moving the resistor on the output to short the channels. This jumper is identified throughout this user's guide.

1.2 Kit Contents

The contents of the EVM kit is listed in Table 1-1. Contact the Texas Instruments Product Information Center nearest if any component is missing.

Table 1-1. Kit Contents

Item	Quantity
HCXX-BASE-EVM	1
1HC03-MOD-EVM	1
1HC04-MOD-EVM	1
1HC08-MOD-EVM	1
2HC08-MOD-EVM	1
2HC16-MOD-EVM	1
BLANK-MOD-EVM	1

1.3 Specification

The HCXX-BASE-EVM is compatible with the TPSxHCxx low R_{ON} family. The unit that is populated on the 2HC08-MOD-EVM is listed in Table 1-2. Please refer to the device data sheet for more detailed specifications.

Table 1-2. 2HC08-MOD-EVM Device Specifications

Part Number	Continuous Load Current (All Channels Enabled)	Channel Count	Package
TPS2HC08-Q1	7.5A	2	VAH (QFN, 11)

1.4 Device Information

The TPSxHCxx are single and dual-channel smart high-side switches, with integrated NMOS power FETs and charge pump, designed to meet the requirements of 12V automotive battery systems.

Full diagnostics and high accuracy current sense features enable intelligent control of the load. The device diagnostic reporting has two versions to support both digital status output and analog current sense report. External programmable current limit improves the system’s reliability by limiting the inrush or overload current.

2 Hardware

2.1 Connection Descriptions

This section describes the connections on the EVM and how to properly connect, set up, and use the HCXX-BASE-EVM.

2.1.1 Connections and Test Points

Connector and Test Point	Description
T1, TP5	Supply voltage VBB
T2, TP1	Output voltage OUT1
T3, TP8	Output voltage OUT2
T4	OUT1 GND
T5	OUT2 GND
TP15, TP16	System GND
TP18	GND_IC test point
TP2, TP3	ENABLE test points EN1 and EN2
TP7	ILIM test point
TP6	SEL test point
TP4	DIAG_EN test point
TP9, TP10	FLT test point and FLT_IC test point
TP11, TP12	SNS test point and SNS_IC test point
TP14	LDO voltage input (VBB)
TP19	LDO voltage output (+5V)

2.1.2 Jumper Configurations

Jumper	Function, Settings
J1	Input diode bypass
J2	Open-load detection pull-up configuration (OUT1)
J3	Diode and TVS for PWM-controlled inductive loads (OUT1)
J4	Module connection ILIM and VOUT1 (left)
J5	Module connection SNS, FLT, and VOUT2 (right)
J6	GND network bypass
J7	RILIM bypass
J8	Open-load detection pull-up configuration (OUT2)
J9	Connect 2 and 3 to enable LDO
J10	Diode and TVS for PWM-controlled inductive loads (OUT2)
J11	Connect 2 and 3 to power EN1 with 5V from LDO
J12	Connect 2 and 3 to power EN2 with 5V from LDO
J13	Connect 2 and 3 to power DIAG_EN with 5V from LDO
J14	Connect 2 and 3 to power SEL with 5V from LDO
J15	LDO voltage output (+5V)
J16	LDO voltage input (VBB)

3 Implementation Results

3.1 Variable Resistor for CS and CL

3.1.1 Current Sense Resistor

The high-accuracy current-sense function is internally implemented, which allows a better real-time monitoring effect and more accurate diagnostics without further calibration. A current mirror is used to source 1 / KSNS of the load current, flowing out to the external resistor between the SNS pin and GND, and reflected as voltage on the SNS pin.

The HCXX-BASE-EVM resistor is located on pad R12. This can be adjusted externally but do take into consideration temperature and supply voltage.

3.1.2 Adjustable Current Limit

The current limit of the device can be adjusted via an external resistor on the ILIM pin. The value which is set by the ILIM pin is applied to both the channels. The device provides ILIM settings with a thermal regulated current limit which adjusts the current limit level based on the relative temperature of the FET and the controller to enable the device to charge up large capacitors at start-up. The device also offers ILIM settings without thermal regulation where the device limits the current at the set ILIM value.

The EVM can be designed to hold different current limit values through a potentiometer (R7) or resistor (R15).

4 Hardware Design Files

4.1 HCXX-BASE-EVM Schematic

The EVM schematic is illustrated in Figure 4-1.

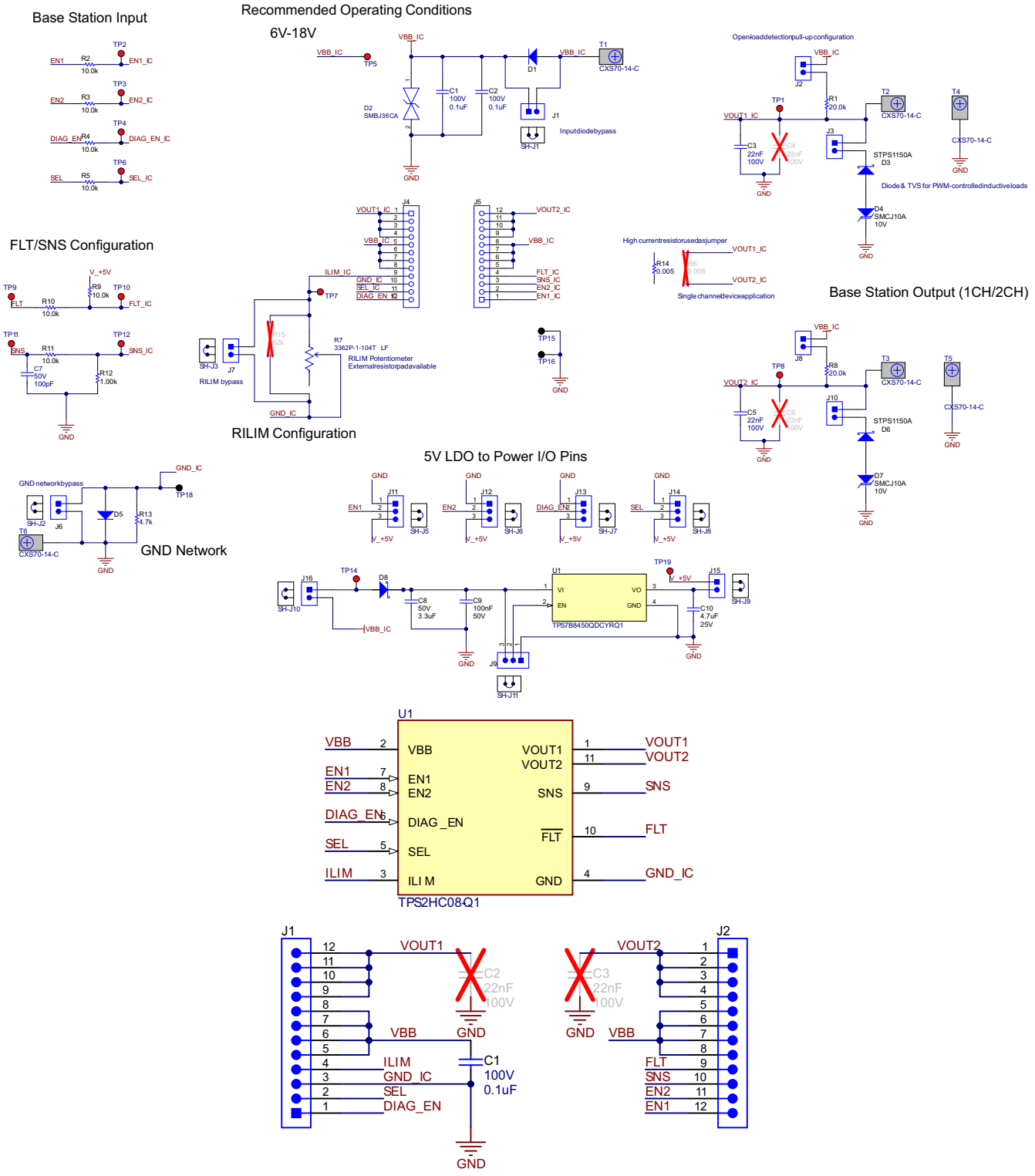


Figure 4-1. HCXX-BASE-EVM and 2HC08-MOD-EVM Schematic

4.2 HCXX-BASE-EVM Assembly Drawings and Layout

The design of the HCXX-BASE-EVM and 2HC08-MOD-EVM printed-circuit board (PCB) is shown in Figure 4-2 to Figure 4-5. The EVM is designed using FR4 material, four-layer (2s2p), 2 × 70µm cubic inch top and bottom layers, and 2 × 35µm cubic inch internal plane layers. All components are in an active area on the top side and all active traces are in the top and bottom layers to allow the user to easily view, probe, and evaluate. Moving components to both sides of the PCB offers additional size reduction for space-constrained systems.

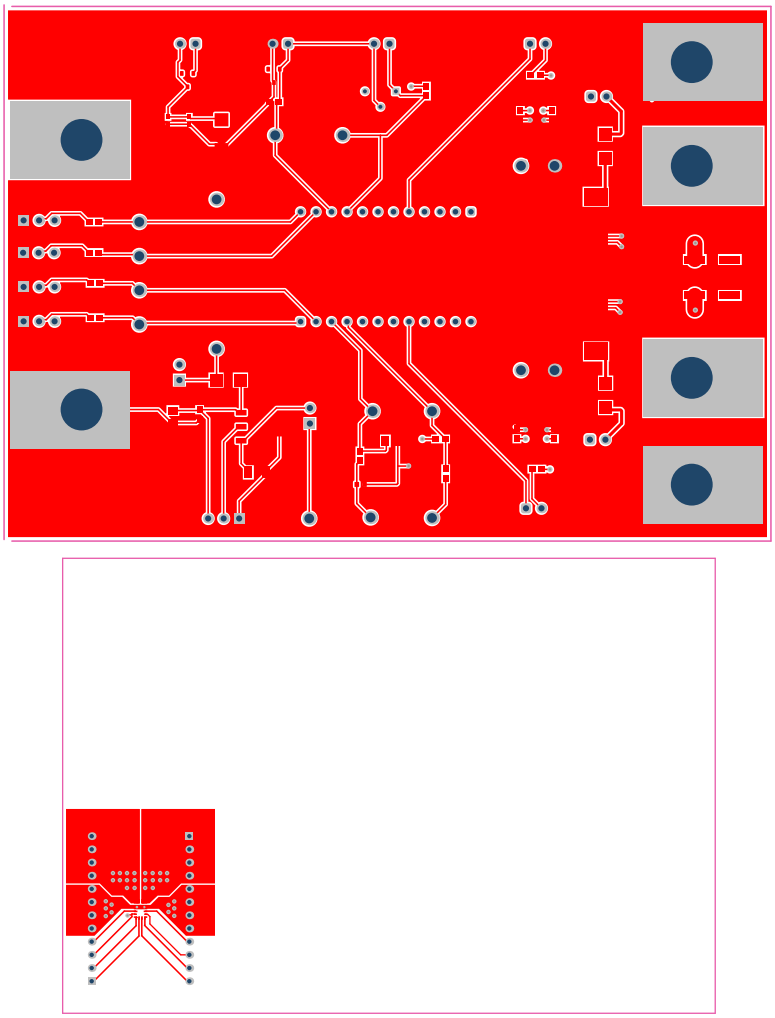


Figure 4-2. HCXX-BASE-EVM and 2HC08-MOD-EVM First Layer (Top View)

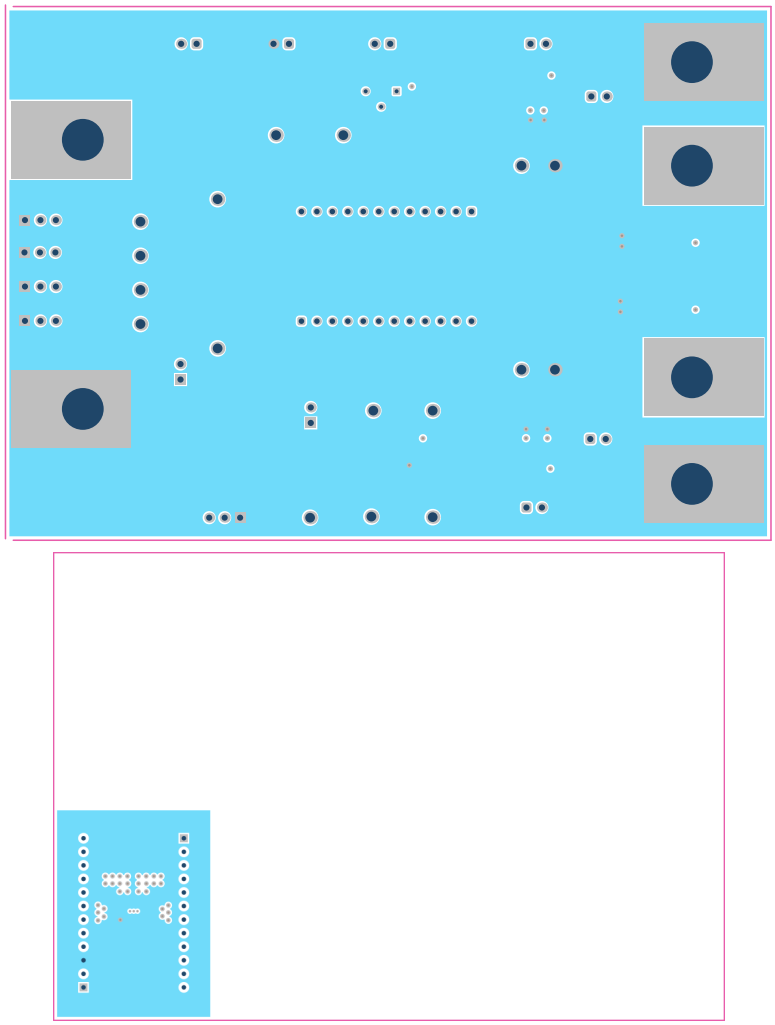


Figure 4-3. HCXX-BASE-EVM and 2HC08-MOD-EVM Second Layer GND (Top View)

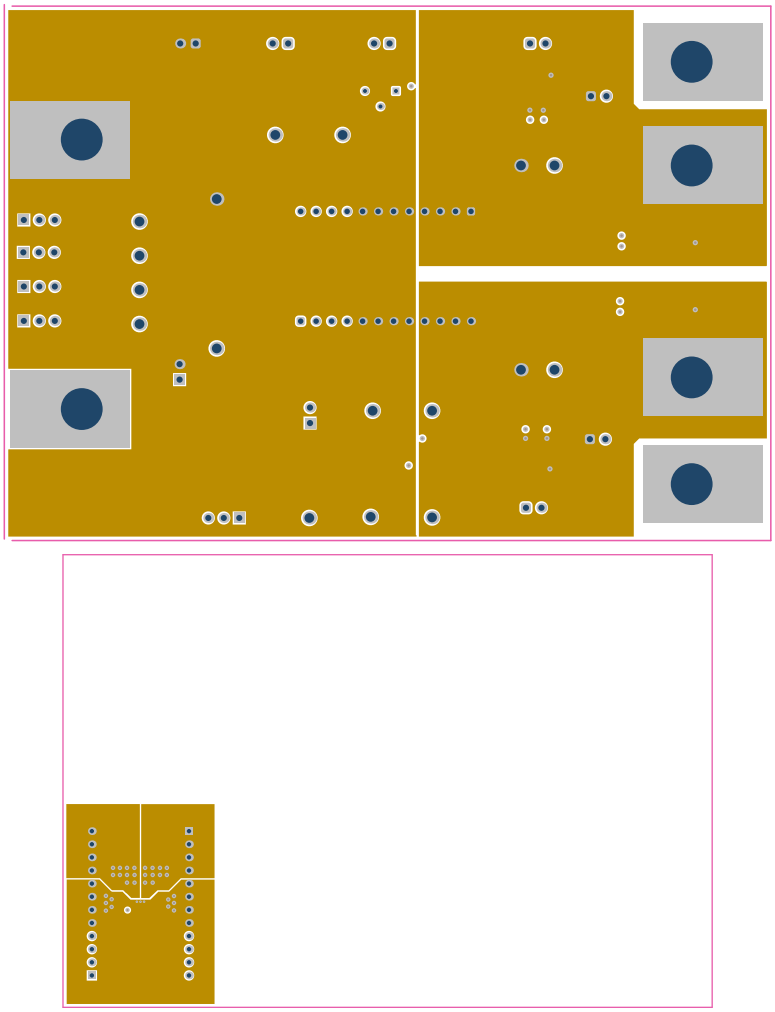


Figure 4-4. HCXX-BASE-EVM and 2HC08-MOD-EVM Third Layer VCC (Top View)

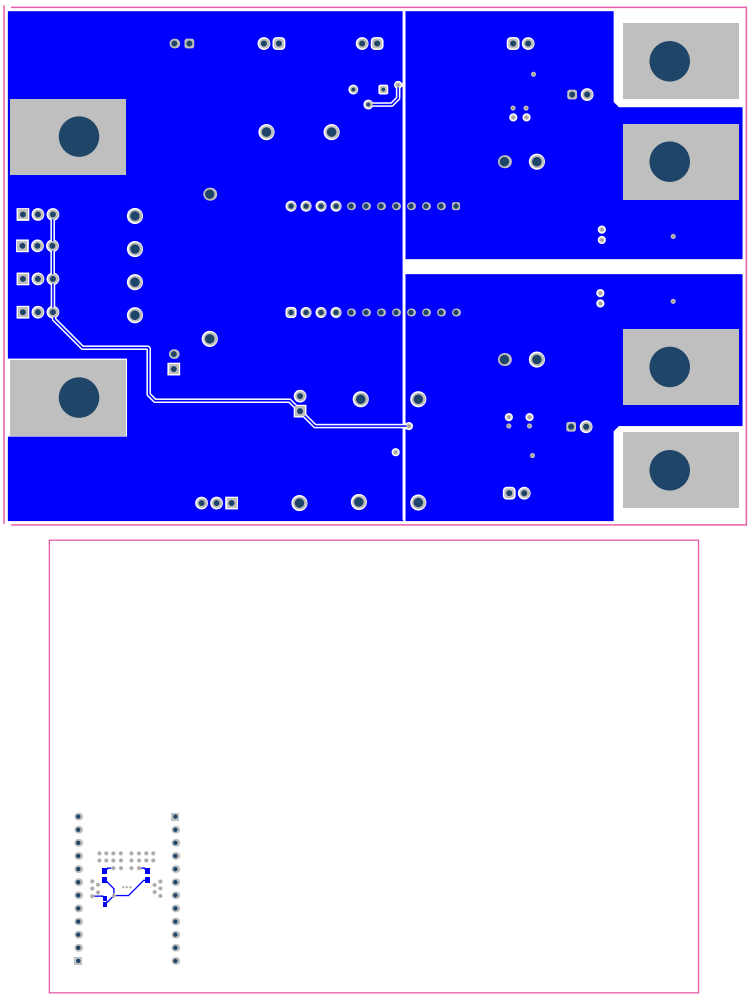


Figure 4-5. HCXX-BASE-EVM and 2HC08-MOD-EVM Fourth Layer (Top View)

4.3 Bill of Materials (BOM)

The HCXX-BASE-EVM bill of materials (BOM) is listed in Table 4-1. The 2HC08-MOD-EVM BOM is listed in Table 4-2.

Table 4-1. HCXX-BASE-EVM BOM

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
C1, C2	2	0.1uF	CAP, CERM, 0.1uF, 100V, +/- 10%, X5R, 0402	0402	GRM155R62A104KE14D	MuRata
C3, C5	2	0.022uF	CAP, CERM, 0.022uF, 100V, +/- 10%, X7R, 0603	0603	C1608X7R2A223K080AA	TDK
C7	1	100pF	Cap Ceramic 100pF 50V C0G ±5% Pad SMD 0603 +125°C T/R	0603	CL10C101JB8NNNC	Samsung
C8	1	3.3uF	CAP, CERM, 3.3uF, 50V, +/- 10%, X5R, 0805	0805	C2012X5R1H335K125AB	TDK
C9	1	0.1uF	CAP, CERM, 0.1µF, 50V,+/- 10%, X7R, AEC-Q200 Grade 1, 0603	0603	C0603C104K5RACAUTO	Kemet
C10	1	4.7uF	CAP, CERM, 4.7uF, 25V, +/- 10%, X5R, 1206	1206	12063D475KAT2A	AVX
D1, D5	2	200V	Diode, Switching, 200V, 0.2A, SOT-23	SOT-23	BAS21-7-F	Diodes Inc.
D2	1		Diode TVS Single Bi-Dir 36V 600W 2-Pin SMB	DO-214AA	SMBJ36CA	Littelfuse
D3, D6	2	150V	Diode, Schottky, 150V, 1A, SMA	SMA	STPS1150A	STMicroelectronics
D4, D7	2	10V	Diode, TVS, Uni, 10V, SMC	SMC	SMCJ10A	Bourns
D8	1	50V	Diode, Schottky, 50V, 1A, SMA	SMA	B150-13-F	Diodes Inc.
H9, H10, H11, H12	4		Bumpon, Hemisphere, 0.44 X 0.20, Clear	Transparent Bumpon	SJ-5303 (CLEAR)	3M
J1, J2, J3, J6, J7, J8, J10	7		Header, 100mil, 2x1, Gold, TH	2x1 Header	TSW-102-07-G-S	Samtec
J4, J5	2		Receptacle, 2.54mm, 12x1, Gold, TH	Receptacle, 2.54mm, 12x1, TH	801-47-012-10-012000	Mill-Max
J9, J11, J12, J13, J14	5		Header, 100mil, 3x1, Tin, TH	Header, 3x1, 100mil, TH	5-146278-3	TE Connectivity
J15, J16	2		Header, 100mil, 2x1, Tin, TH	Header 2x1	90120-0122	Molex
R1, R8	2	20.0k	RES, 20.0 k, 0.5%, 0.1 W, 0603	0603	MCR03EZPD2002	Rohm
R2, R3, R4, R5, R9, R10, R11	7	10.0k	RES, 10.0 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW060310K0FKEA	Vishay-Dale
R7	1	100kΩ	Res Cermet Trimmer 100K Ohm 10% 1/2W 1(Elec)/1(Mech)Turn 5mm (6.71 X 7.04 X 14.63mm) Pin Thru-Hole Tube	PTH_TRIMMER_6MM60_6MM99	3362P-1-104TLF	Bourns
R12	1	1.00k	RES, 1.00 k, 1%, 0.25 W, 0805	0805	ERJ-P06F1001V	Panasonic
R13	1	4.7k	RES, 4.7 k, 5%, 0.1 W, 0603	0603	CR0603-JW-472GLF	Bourns

Table 4-1. HCXX-BASE-EVM BOM (continued)

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
R14	1	0.005	RES, 0.005, 1%, 2 W, 2512	2512	PMR100HZPFU5L00	Rohm
SH-J1, SH-J2, SH-J3, SH-J5, SH-J6, SH-J7, SH-J8, SH-J9, SH-J10, SH-J11	10	1x2	Shunt, 100mil, Gold plated, Black	Shunt	SNT-100-BK-G	Samtec
T1, T2, T3, T4, T5, T6	6		Terminal 70A Lug	LUG, 32.3x14.5x11.7	CXS70-14-C	Panduit
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP14, TP19	14		Test Point, Multipurpose, Red, TH	Red Multipurpose Testpoint	5010	Keystone
TP15, TP16, TP18	3		Test Point, Multipurpose, Black, TH	Black Multipurpose Testpoint	5011	Keystone
U1	1		150mA, wide VIN, low IQ, low-dropout regulator, DCY0004A (SOT-223-4)	DCY0004A	TPS7B8450QDCYRQ1	Texas Instruments
R6	0	0.005	RES, 0.005, 1%, 2 W, 2512	2512	PMR100HZPFU5L00	Rohm
R15	0	62k	RES, 62 k, 5%, 0.1 W, 0603	0603	RC0603JR-0762KL	Yageo

Table 4-2. 2HC08-MOD-EVM BOM

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
C1	1	0.1uF	CAP, CERM, 0.1uF, 100V, +/- 10%, X5R, 0402	0402	GRM155R62A104KE14D	MuRata
J1, J2	2		Header, 100mil, 12x1, TH	Header, 12x1, 100mil, TH	800-10-012-10-001000	Mill-Max
U1	1		TPS2HC08-Q1	VQFN-HR11	TPS2HC08-Q1	Texas Instruments
C2, C3	0	0.022uF	CAP, CERM, 0.022uF, 100V, +/- 10%, X7R, 0603	0603	C1608X7R2A223K080AA	TDK

5 Additional Information

5.1 Trademarks

All trademarks are the property of their respective owners.

6 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision * (March 2025) to Revision A (June 2025)	Page
• Updated the document with more details pertaining to the EVM and EVM capabilities	1
• Updated board images	1

STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an “EVM” or “EVMs”) to the User (“User”) in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.

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   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.

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   2.1 These terms 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 a nonconforming EVM if (a) the nonconformity was 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, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

   2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, 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.

WARNING

Evaluation Kits 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 shall operate the Evaluation Kit within TI’s recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI’s recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI’s instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGREDATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

3 *Regulatory Notices:*

3.1 *United States*

3.1.1 *Notice applicable to EVMs not FCC-Approved:*

FCC NOTICE: 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 or RSS-247*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. 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/lsds/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。

https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html

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 to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

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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1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
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3. 技術基準適合証明を取得後ご使用いただく。

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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/lsds/ti_ja/general/eStore/notice_02.page

電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-for-power-line-communication.html

3.4 *European Union*

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive)*:

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

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.

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