

# EVM User's Guide: TLC3555EVM

## TLC3555 Evaluation Module



### Description

The TLC3555EVM evaluation module (EVM) is designed to help users easily evaluate and test the operation and functionality of the TLC3555. The EVM can be configured in standard timer circuit configurations for evaluation. The EVM operates on a single-supply from 1.5V to 18V. The default configuration of the EVM is in the astable mode of operation and outputs a square wave at a frequency of approximately 34.7kHz.

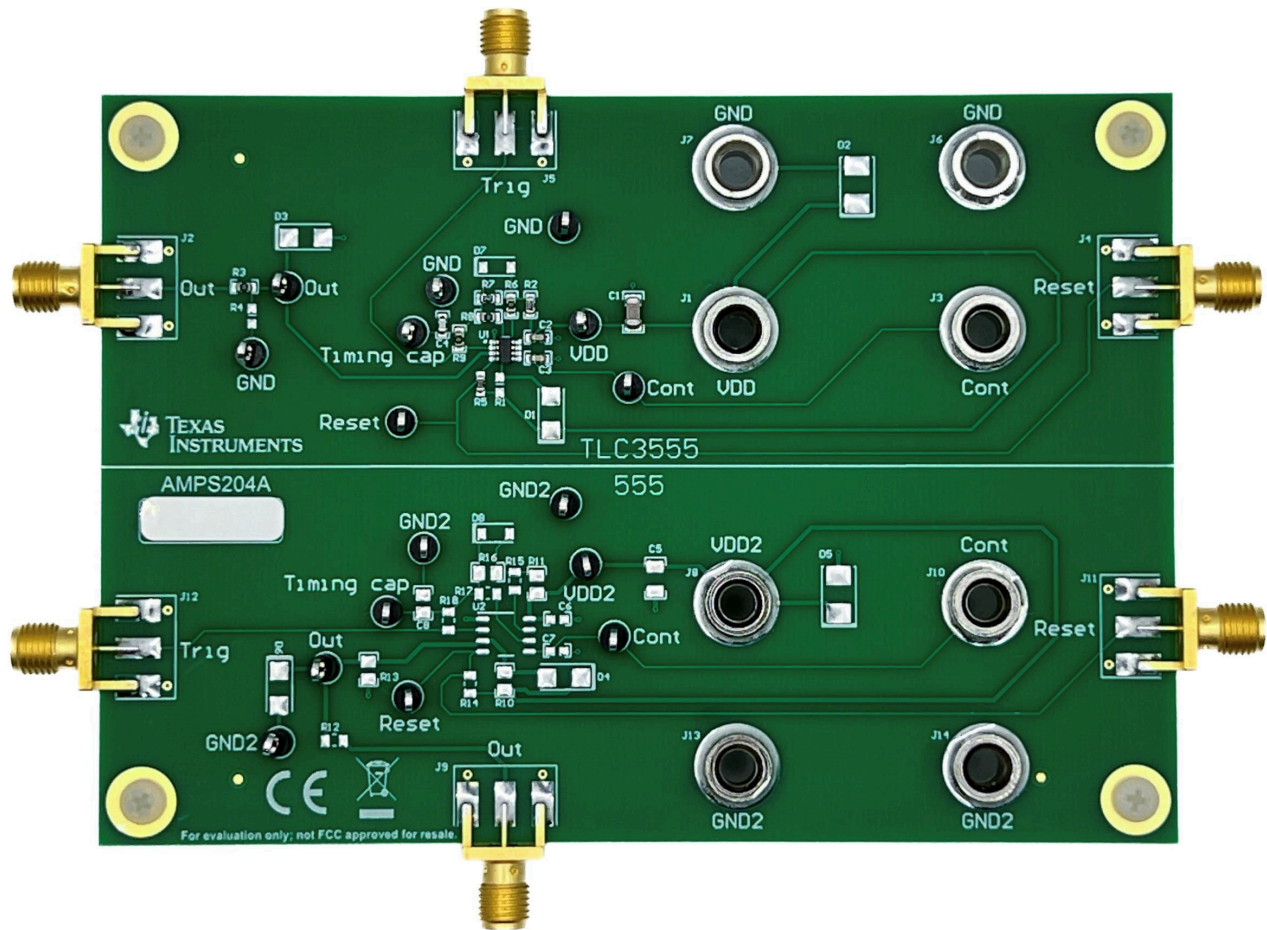
### Features

- SMA and banana connections for input and output
- Convenient test points to all pertinent nodes

- Supports various timer application configurations
- Banana plug connections for power supplies and bias nodes

### Applications

- Precision timing
- Pulse generation
- Sequential timing
- Time delay generation
- Pulse width modulation
- [Pulse position modulation](#)
- Linear ramp generators
- [Automotive lamp and LED lighting](#)
- [Telematics](#)



# 1 Evaluation Module Overview

## 1.1 Introduction

The [TLC3555](#) is a monolithic timing circuit fabricated using the TI LinCMOS™ process. The timer is fully compatible with CMOS, TTL, and MOS logic and operates at frequencies up to 3.5MHz. As a result of the high input impedance, this device uses smaller timing capacitors than those capacitors used by the bipolar NE555 family. And, more accurate time delays and oscillations are possible. Power consumption is low across the full range of power-supply voltage.

This user's guide describes the characteristics, operation, performance, and use of the Texas Instruments' TLC3555 evaluation module.

This user's guide contains information and support documentation for the [TLC3555](#) evaluation module. Included are the circuit description, schematic, and bill of materials of the TLC3555EVM. Throughout this document, the terms evaluation board, evaluation module, and EVM are synonymous with the TLC3555EVM.

## 1.2 Kit Contents

[Table 1-1](#) details the contents of the EVM kit. Contact the nearest TI Product Information Center if any component is missing TLC3555EVM.

**Table 1-1. Contents of TLC3555EVM Kit**

Item	Quantity
TLC3555EVM evaluation board PCB	1

## 1.3 Specification

The TLC3555EVM operates on a single-supply from 1.5V to 18V. The banana connectors labeled VDD and GND supply power to the TLC3555 device.

## 1.4 Device Information

The TLC3555EVM provides a basic functional evaluation of the [TLC3555-Q1](#) device. For typical applications, see the [TLC3555-Q1 data sheet](#).

## 2 Hardware

### 2.1 Getting Started

This section explains the connectors and test points, and details the basic EVM functionality.

#### 2.1.1 Power Supplies

The TLC3555EVM operates on a single-supply from 1.5V to 18V. The banana connectors labeled VDD and GND supply power to the TLC3555 device.

#### 2.1.2 Input

The inputs to the TLC3555EVM are trigger, reset and control. The trigger and reset inputs use SMA connectors and the control pin uses banana connections. The [Design tools and Simulation](#) tab on the [TLC3555-Q1](#) web folder assists with other configurations.

#### 2.1.3 Output

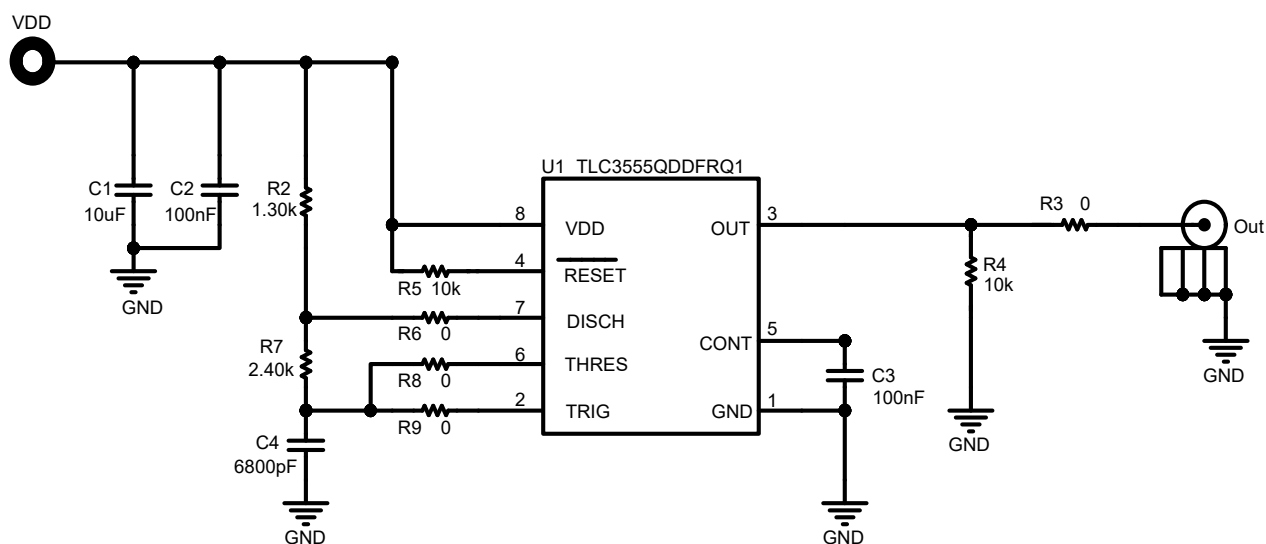
Monitor the EVM output by using the SMA connector labeled Out or the test point labeled Out. Resistor R3 is used as an isolation resistor on the TLC3555 output. Resistor R3 is a 0 ohm resistor and can be adjusted to adhere to application design requirements.

### 2.2 Application Circuit

The TLC3555EVM can be configured in standard timer circuit configurations for evaluation. For typical applications, see the [TLC3555-Q1 data sheet](#). [Figure 3-1](#) shows the full schematic of the EVM. The EVM is populated with components for evaluation of the TLC3555-Q1. Resistors R5, R6, R8, and R9 are populated on pertinent pins providing flexibility for configuration of various application circuits. The EVM provides a copy of the TLC3555EVM circuitry for evaluation of timers in the SOIC package.

#### 2.2.1 Astable Mode

[Figure 2-1](#) shows a simplified schematic of the EVM for the purpose of this application circuit. [Figure 2-1](#) shows the full default configuration of the TLC3555EVM. The EVM operates on a single supply of VDD = 1.5 V to VDD = 18V.

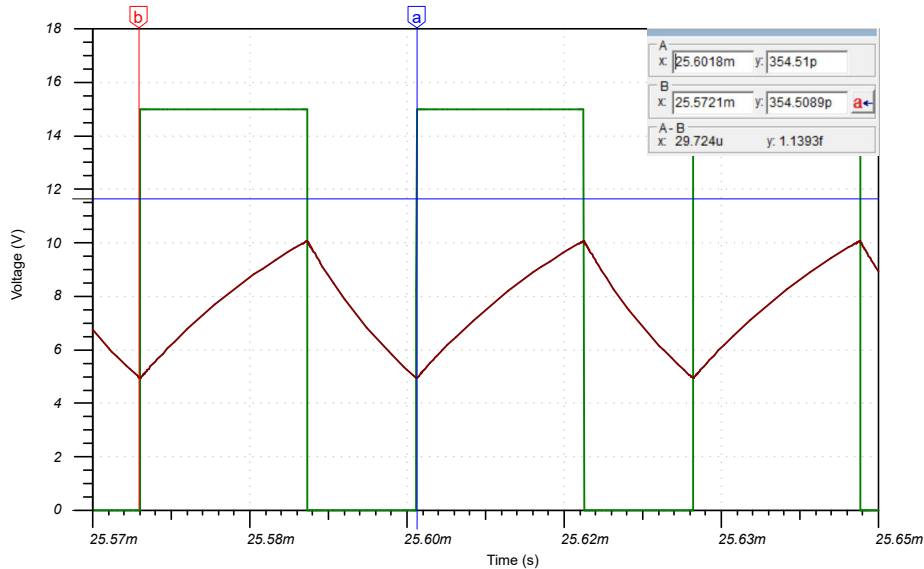


**Figure 2-1. TLC3555 Astable Circuit Configuration**

The default EVM configuration is the Astable mode of operation. [Figure 2-2](#) shows a Tina TI simulation of the Astable configuration shown in [Figure 2-1](#). The power supply is VDD = 15V. The frequency of operation can be calculated using [Equation 1](#).

$$f \approx \frac{1.44}{(R_2 + 2R_7)C_4} \text{ Hz} \quad (1)$$

$$f \approx \frac{1.44}{(1.3 \text{ k}\Omega + 2 \times 2.40 \text{ k}\Omega)6.8 \text{ nF}} \approx 34.7 \text{ kHz} \quad (2)$$



**Figure 2-2. TLC3555 Astable Simulation with VDD = 15V**

### 2.3 Evaluation Module Limitations

The default TLC3555EVM configuration operates within the specified voltage and current regions of the [TLC3555-Q1](#). User modifications can be made to the TLC3555EVM. Reference the respective product data sheet to maintain the specified operating conditions for the device. In addition to observing the specified current and voltage levels, use proper electrostatic discharge precautions when handling and applying the EVM.

### 2.4 Electrostatic Discharge Caution

#### CAUTION

Many of the components on the TLC3555EVM are susceptible to damage by electrostatic discharge (ESD). Use proper ESD handling precautions when unpacking and handling the EVM. Failure to observe ESD handling procedures can result in damage to the EVM components.

### 3 Hardware Design Files

#### 3.1 Schematic

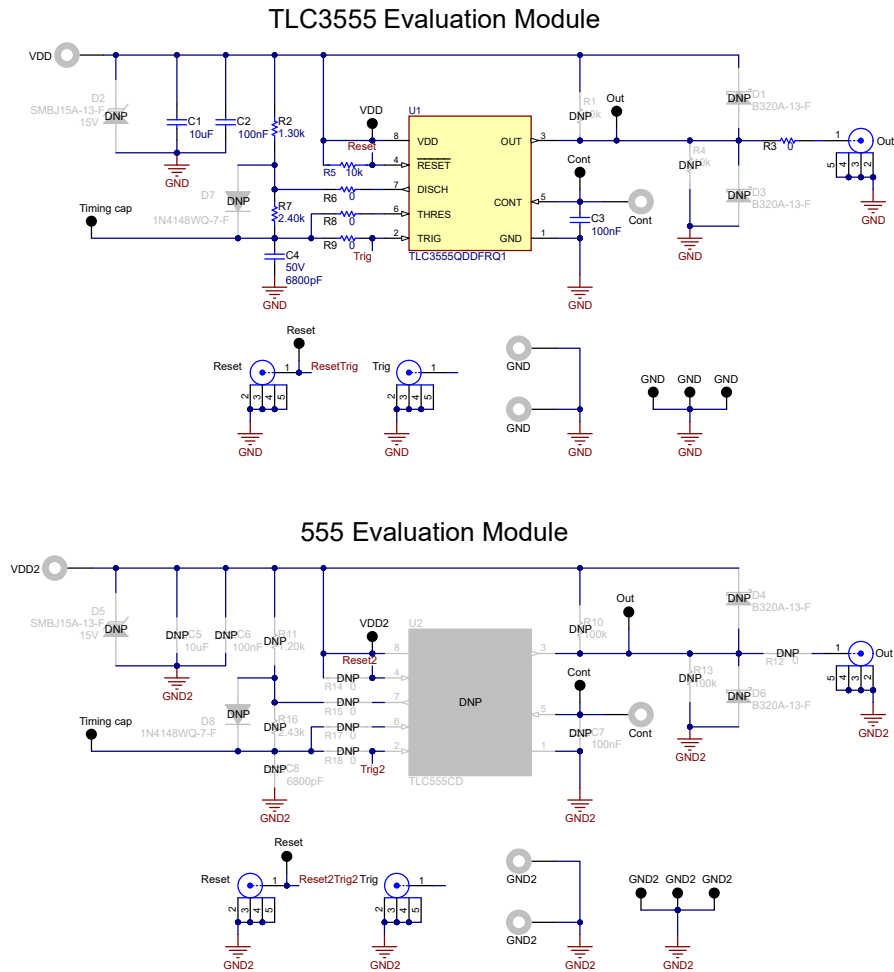
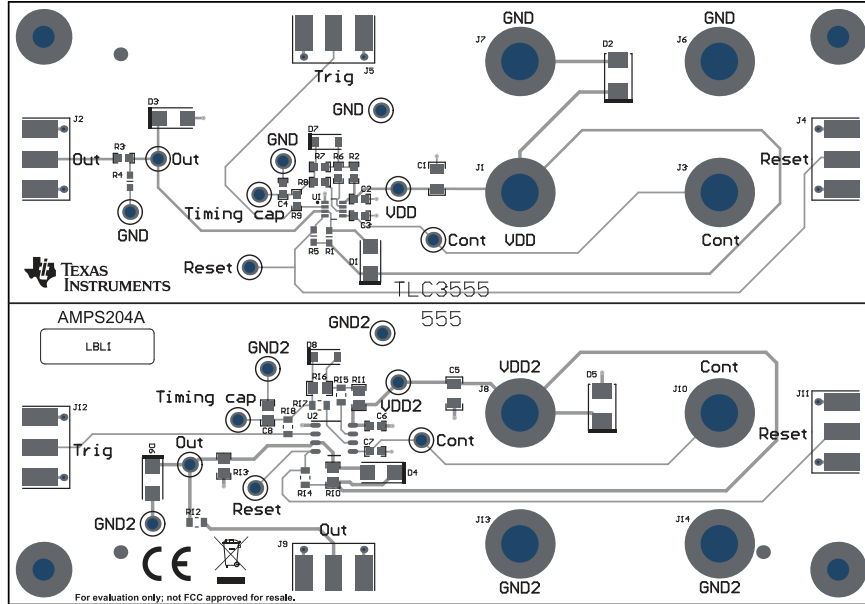
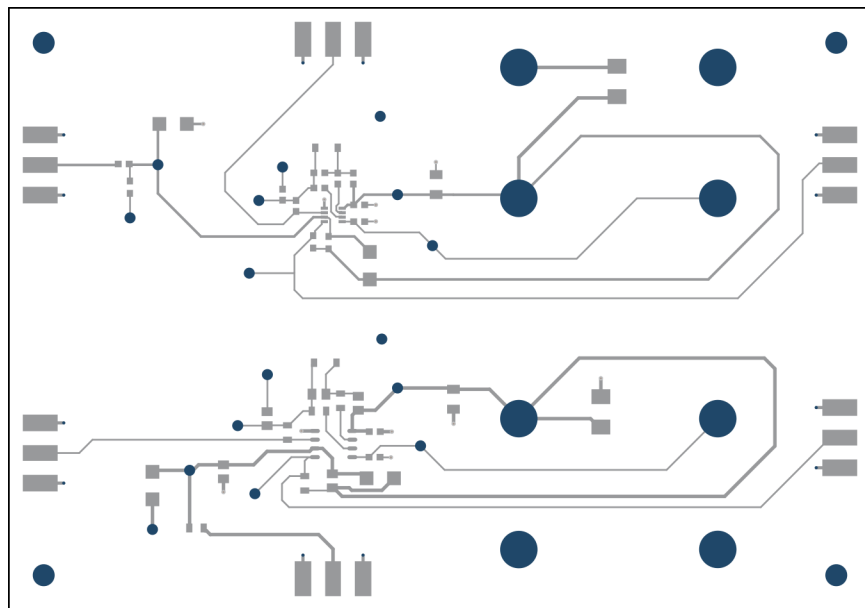


Figure 3-1. TLC3555EVM Default Configuration Schematic

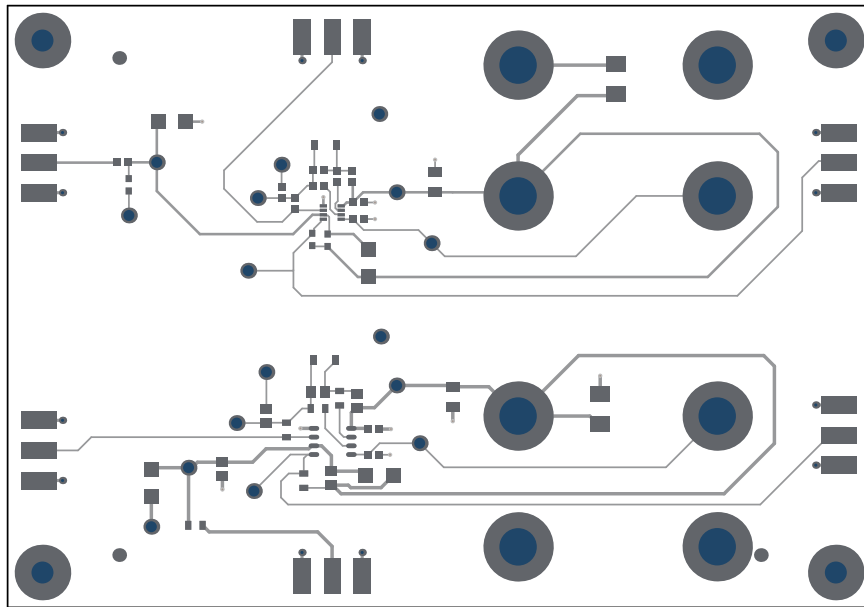
### 3.2 PCB Layout



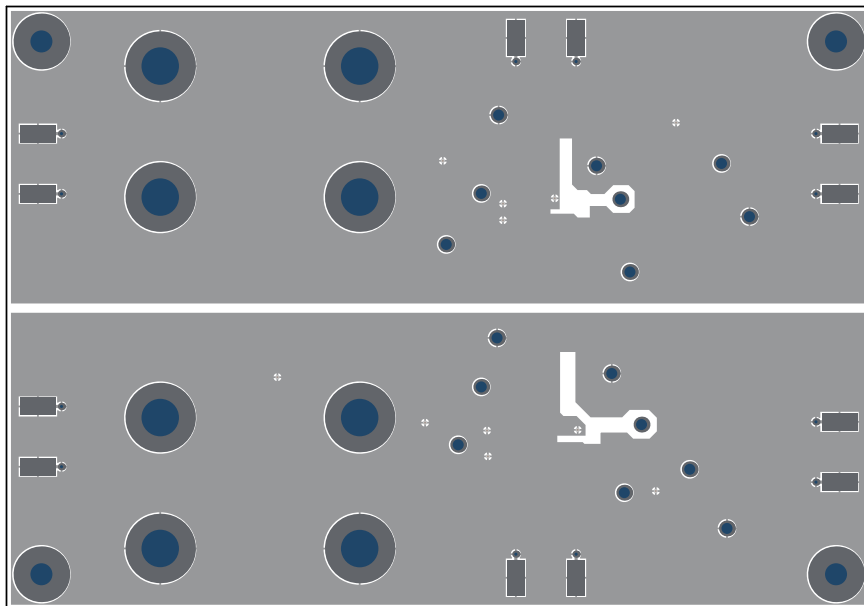
**Figure 3-2. TLC3555EVM PCB Layout Top View Composite**



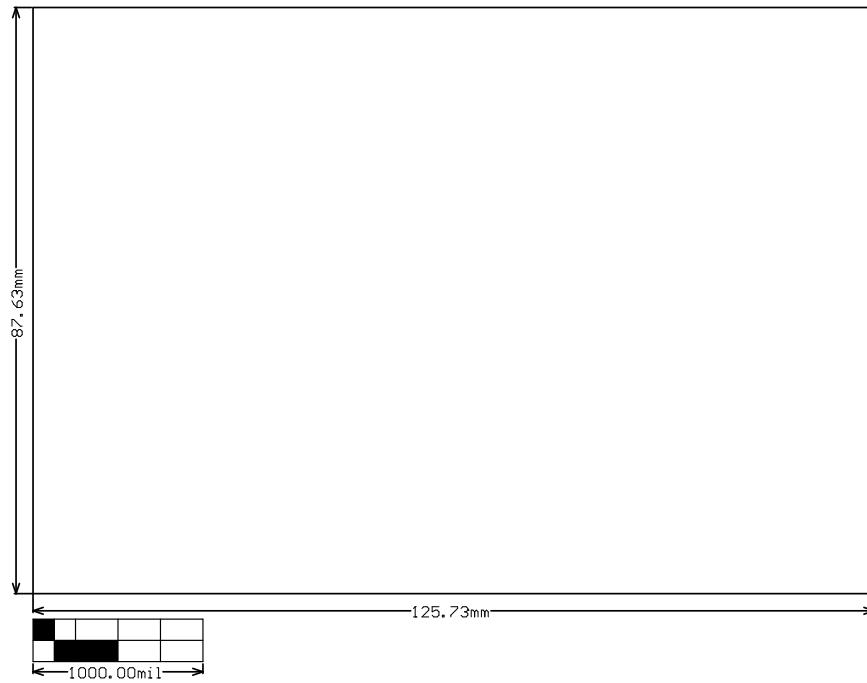
**Figure 3-3. TLC3555EVM Top Layer**



**Figure 3-4. TLC3555EVM Top Layer Mask**



**Figure 3-5. TLC3555EVM Bottom View Composite**



**Figure 3-6. TLC3555EVM Board Dimensions**



### 3.3 Bill of Materials

Table 3-1 lists the complete bill of materials for the TLC3555EVM. Data for each component are available from the corresponding manufacturer web site.

**Table 3-1. TLC3555EVM BOM**

Designator	Quantity	Value	Description	Part Number	Manufacturer
C1	1	10uF	CAP, CERM, 10uF, 35V, +/- 10%, X7R, 1206	GMK316AB7106KL	Taiyo Yuden
C2, C3	2	0.1uF	CAP, CERM, 0.1uF, 25V, +/- 5%, X7R, 0603	C0603C104J3RACTU	Kemet
C4	1	6800pF	CAP, CERM, 6800pF, 50V,+/- 5%, C0G/NP0, 0603	GRM1885C1H682JA01D	MuRata
H1, H2, H3, H4	4		Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	NY PMS 440 0025 PH	B&F Fastener Supply
H5, H6, H7, H8	4		Standoff, Hex, 0.5"L #4-40 Nylon	1902C	Keystone
J1, J3, J6, J7, J8, J10, J13, J14	8		Standard Banana Jack, Uninsulated, 5.5mm	575-4	Keystone
J2, J4, J5, J9, J11, J12	6		Connector, End launch SMA, 50 ohm, SMT	142-0701-801	Cinch Connectivity
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	THT-14-423-10	Brady
R2	1	1.30k	RES, 1.30 k, 0.1%, 0.1 W, 0603	RG1608P-132-B-T5	Susumu Co Ltd
R3, R6, R8, R9	4	0	RES, 0, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	RMCF0603ZT0R00	Stackpole Electronics Inc
R5	1	10k	10 kOhms ±0.1% 0.1W, 1/10W Chip Resistor 0603 (1608 Metric) Current Sense Thin Film	CRT0603-BY-1002ELF	Bourns Inc.
R7	1	2.40k	RES, 2.40 k, 0.1%, 0.1 W, 0603	RT0603BRD072K4L	Yageo America
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16	16		Test Point, Multipurpose, Black, TH	5011	Keystone Electronics
U1	1		Automotive High-Speed CMOS Timer	TLC3555QDDFRQ1	Texas Instruments

## 4 Additional Information

### 4.1 Trademarks

LinCMOS™ is a trademark of Texas Instruments.  
All trademarks are the property of their respective owners.

## 5 Related Documentation

[Table 5-1](#) lists the documents that provide information about TI's integrated circuits and support tools for the TLC3555EVM.

**Table 5-1. Related Documentation**

Document	Literature Number
<a href="#">TLC3555-Q1</a> product data sheet	<a href="#">SLFS083</a>

## 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.
  - 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 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 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 DEGRADATION 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/llds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/llds/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.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けていないものがあります。技術適合証明を受けていないものご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

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。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

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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](http://www.tij.co.jp/llds/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.

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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 MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS 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 EPIDEMIC FAILURE WARRANTY OR 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.
    - 6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.
  7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.
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8. *Limitations on Damages and Liability:*

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 OR THE USE OF THE EVMS , 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 TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

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