



UM10727

GreenChip TEA1708T automatic discharge for X capacitors demo board

Rev. 1 — 3 October 2013

User manual

Document information

Info	Content
Keywords	TEA1708T, APBADC073, discharge, X capacitor, SO8, low power consumption, discharge current, surge protection, demo board
Abstract	This user manual describes how the TEA1708T APBADC073 demo board can be used in a power converter to add the automatic discharge for X capacitor functionality. It also provides recommendations for integration of the TEA1708T in a power adapter printed-circuit board. The demo board contains a TEA1708T controller in SO8 package and two resistors and one capacitor. The APBADC073 demo board replaces the resistors that are normally used to discharge the X capacitor. It can be connected directly across the X capacitor terminals for evaluation purposes.



Revision history

Rev	Date	Description
v.1	20131003	first issue

Contact information

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1. Introduction

WARNING

Lethal voltage and fire ignition hazard



The non-insulated high voltages that are present when operating this product, constitute a risk of electric shock, personal injury, death and/or ignition of fire.

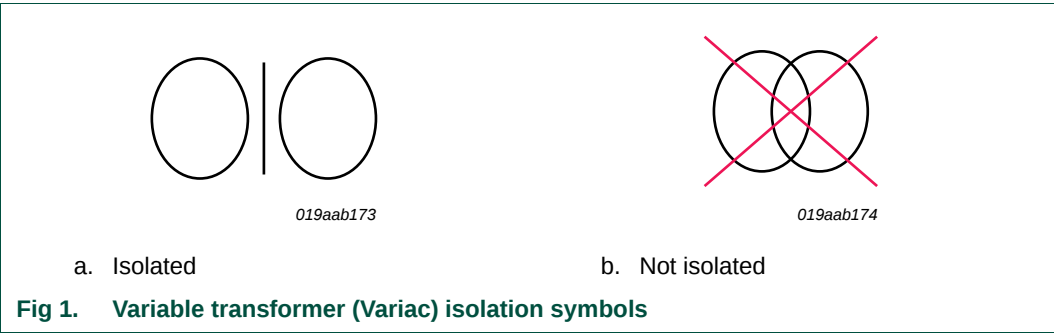
This product is intended for evaluation purposes only. It shall be operated in a designated test area by personnel qualified according to local requirements and labor laws to work with non-insulated mains voltages and high-voltage circuits. This product shall never be operated unattended.

This document describes the TEA1708T APBADC073 demo board. A functional description is provided, supported by a small set of measurements illustrating the performance of the TEA1708T. The demo board can be used standalone or can be hooked up to an existing power supply to demonstrate the capabilities of the TEA1708T.

All values in this user manual are typical values, unless otherwise specified.

2. Safety warnings

The board must be connected to the mains voltage. Touching the board during operation must always be avoided. An isolated housing is obligatory when used in uncontrolled, non-laboratory environments. A galvanic isolation of the mains phase using a variable transformer is always recommended. The symbols shown in [Figure 1](#) indicate these devices.



3. Specification

Table 1. Input specification			
Parameter	Conditions	Value	Comment
input voltage		85 V (AC) to 265 V (AC)	universal mains
input frequency		47 Hz to 63 Hz	
input power		< 1 mW	Power consumption without X capacitor

4. Functional description

The TEA1708T is an automatic discharge IC for X capacitors. It has a low power consumption (< 1 mW at 230 V (AC)). The X-capacitor discharge current is internally limited to 2.3 mA. The discharge delay time is set externally by using a low voltage capacitor.

A 500 V clamping circuit is integrated, which protects the IC during mains surges.

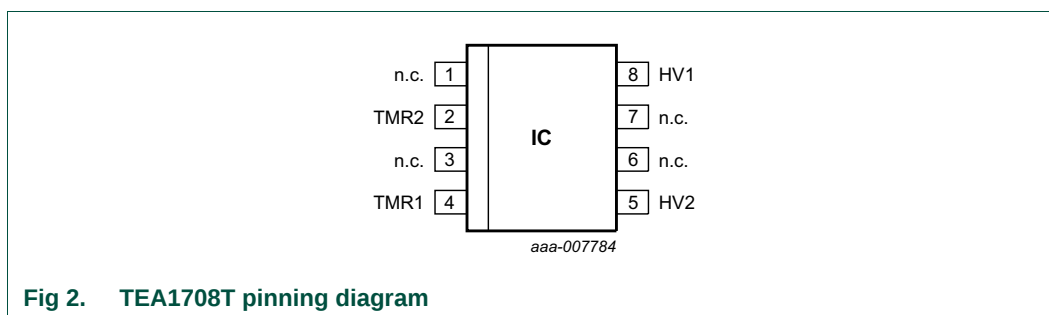


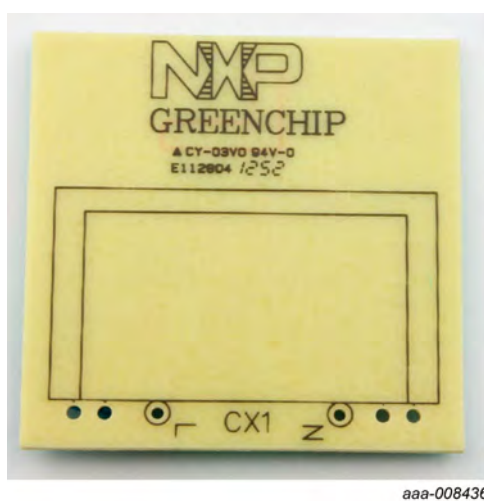
Fig 2. TEA1708T pinning diagram

5. Demo board setup

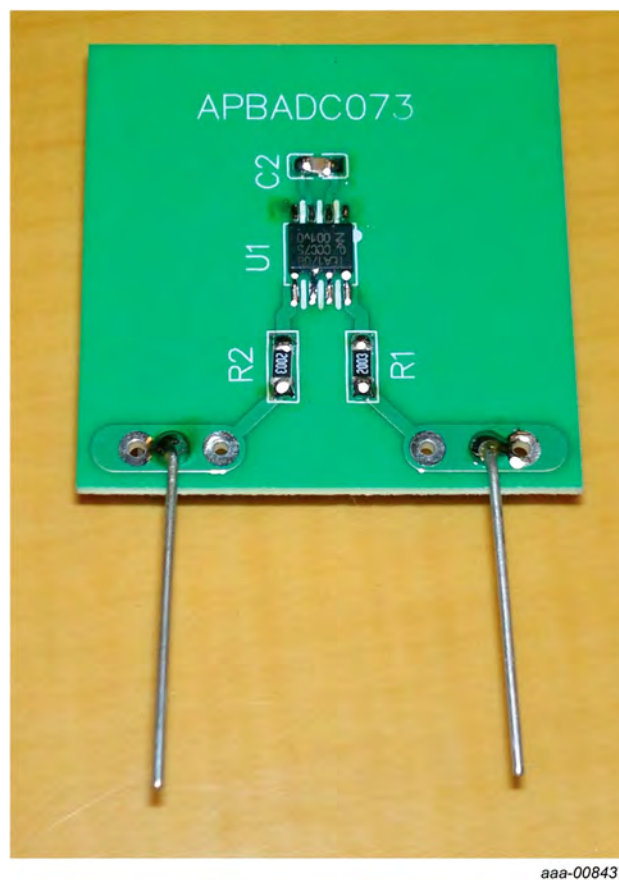
The APBADC073 demo board is designed so it can easily be added across the terminals of the X capacitor in the existing power supply converter. It can also directly substitute the X capacitor of the existing power supply when the X capacitor is mounted on the TEA1708T demo board.

5.1 Demo board APBADC073

The APBADC073 demo board consists of the TEA1708T in an SO8 package, two 200 k Ω discharge resistors, a 10 nF timer capacitor, and a 1 μ F X2 capacitor. [Figure 3](#) shows the front and back side of the demo board.



a. Front



b. Back

Fig 3. APBADC073 demo board

5.2 Connecting the board

The APBADC073 demo board can be directly connected across the X capacitor terminals of the power supply. Either the original X capacitor of the power supply or the X capacitor of the board can be used. Remove the discharge resistors of the original application.

Figure 4 shows the board connections.

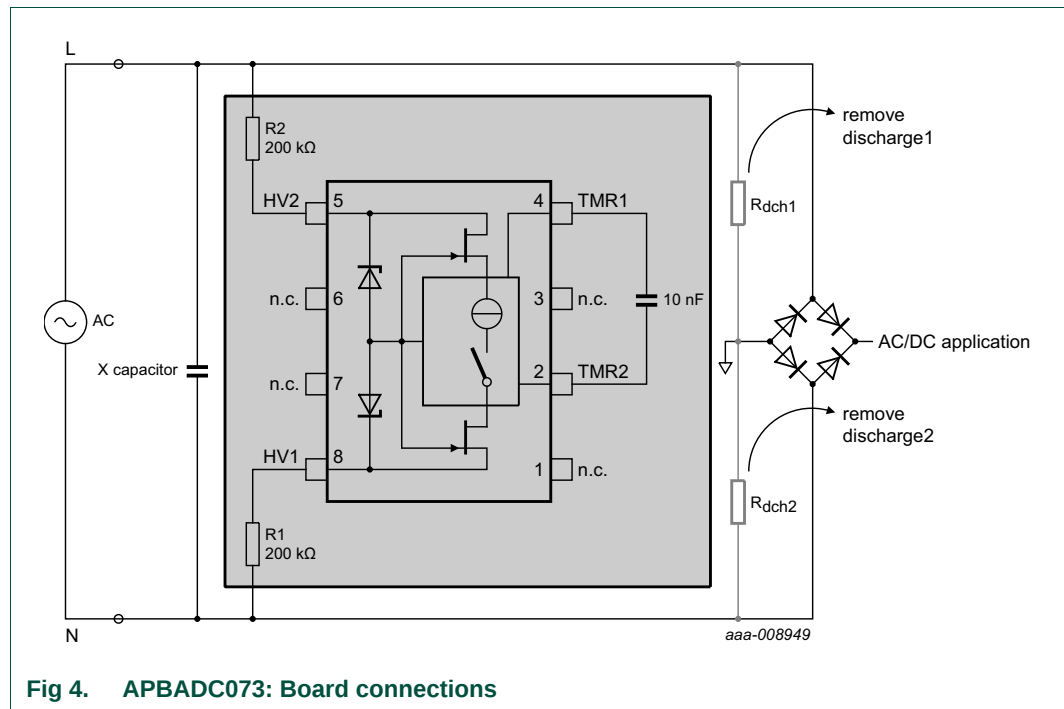


Fig 4. APBADC073: Board connections

6. Measurements

Tests have been carried out to measure the power consumption of the TEA1708T, to test the discharge capacity of the TEA1708T, and to test the surge capability.

6.1 Test setup

The board has been tested standalone.

6.1.1 Test equipment

- AC source: Agilent 6812B
- Power meter: Yokogawa WT210 with harmonics option
- Digital oscilloscope: Yokogawa DL1640L
- 100 MHz, high-voltage differential probe: Yokogawa 700924
- Multimeter: Keithley 2000
- KeyTek EMCPro Plus

6.1.2 Test conditions

- Ambient temperature between 20 °C and 25 °C

6.2 Power consumption

Test conditions:

The APBADC073 demo board is connected to the AC source. The X capacitor must not be connected. For several AC voltages the power consumption is measured with the power meter set to the lowest current value (5 mA), integration time of 36 s, and readout in mWh. The results are given in [Table 2](#).

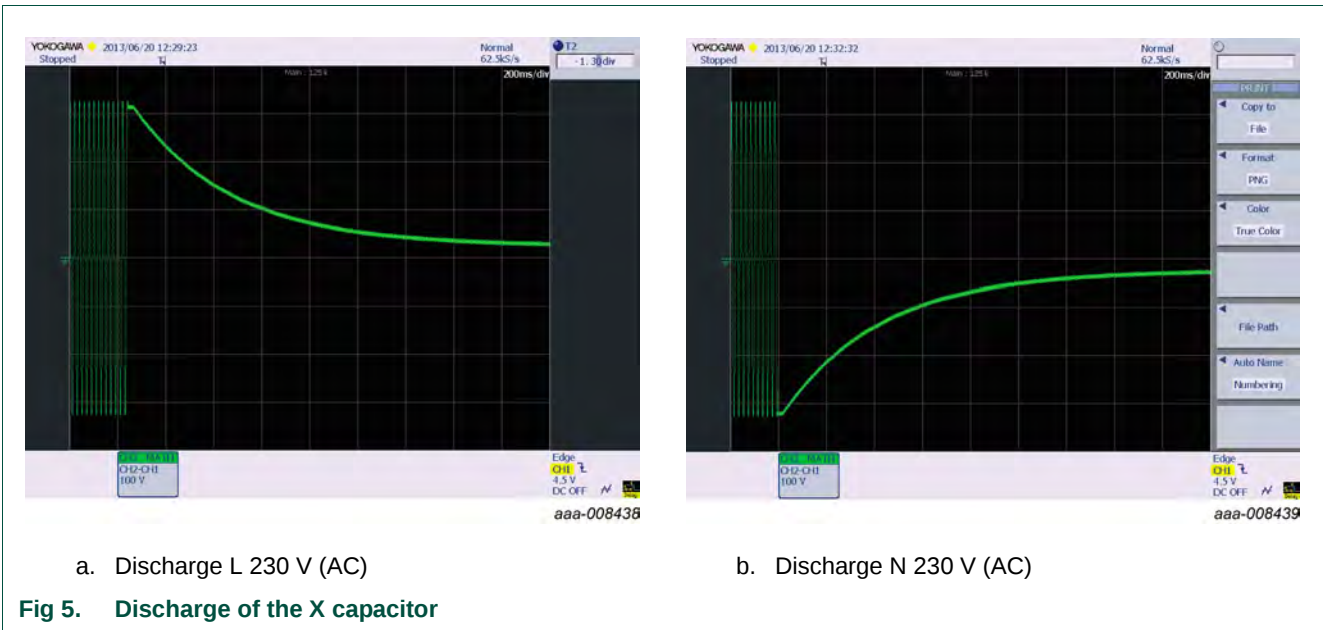
Table 2. Power consumption TEA1708T

V (AC)/60 Hz	Pin	Comments
85 V	0.27 mW	ambient
115 V	0.37 mW	ambient
230 V	0.75 mW	ambient
265 V	0.87 mW	ambient

6.3 Discharge capacity

Test conditions:

The board with the 1 μ F X capacitor is connected to the AC source (230 V (AC)/50 Hz). A differential probe is directly connected across the terminals of the X capacitor. When the AC source is disconnected, the TEA1708T starts to discharge the X capacitor through resistors R1 and R2 (both 200 k Ω). [Figure 5](#) shows the discharge curve.



[Table 3](#) shows the time that is required to discharge the X capacitor for three different values of this X capacitor.

Table 3. Discharge time

X capacitor value (nF)	Discharge time (135 V) (ms)	Discharge time (60 V) (ms)
470	200	420
1000	420	870
2000	810	1700

6.4 Surge capability

Test conditions:

- The APBADC073 demo board without the X capacitor is connected to the surge generator KeyTek EMCPro Plus
- The applied voltage (AC) is 230 V/50 Hz
- Resistors R1 and R2 are both 200 kΩ. In total 6 x 68 kΩ is used to ensure that the resistors are not damaged by the high-voltage surge pulses.

Surge testing requirements: IEC61000-4-5.

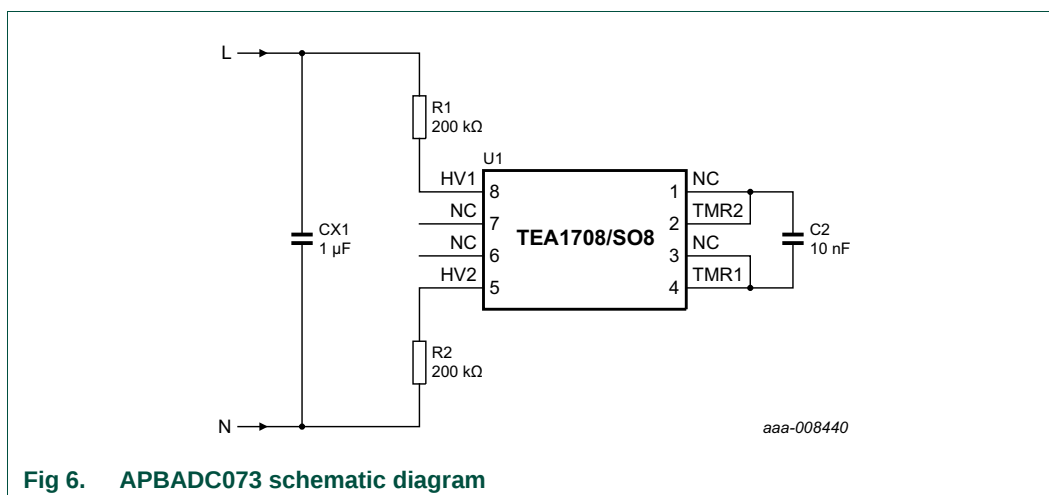
Table 4. Setup for surge testing

Parameter	Setting 1	Setting 2	Setting 3
waveform	SRG 1.2/50	user defined	2 Ω
surge pulses	1, 2, 4, 6 kV		
output coupling	mains L, N		
phase reference	0, 90, 180, 270 °		
number of tests	5		
time between tests	15 s		

Table 5. Surge test results

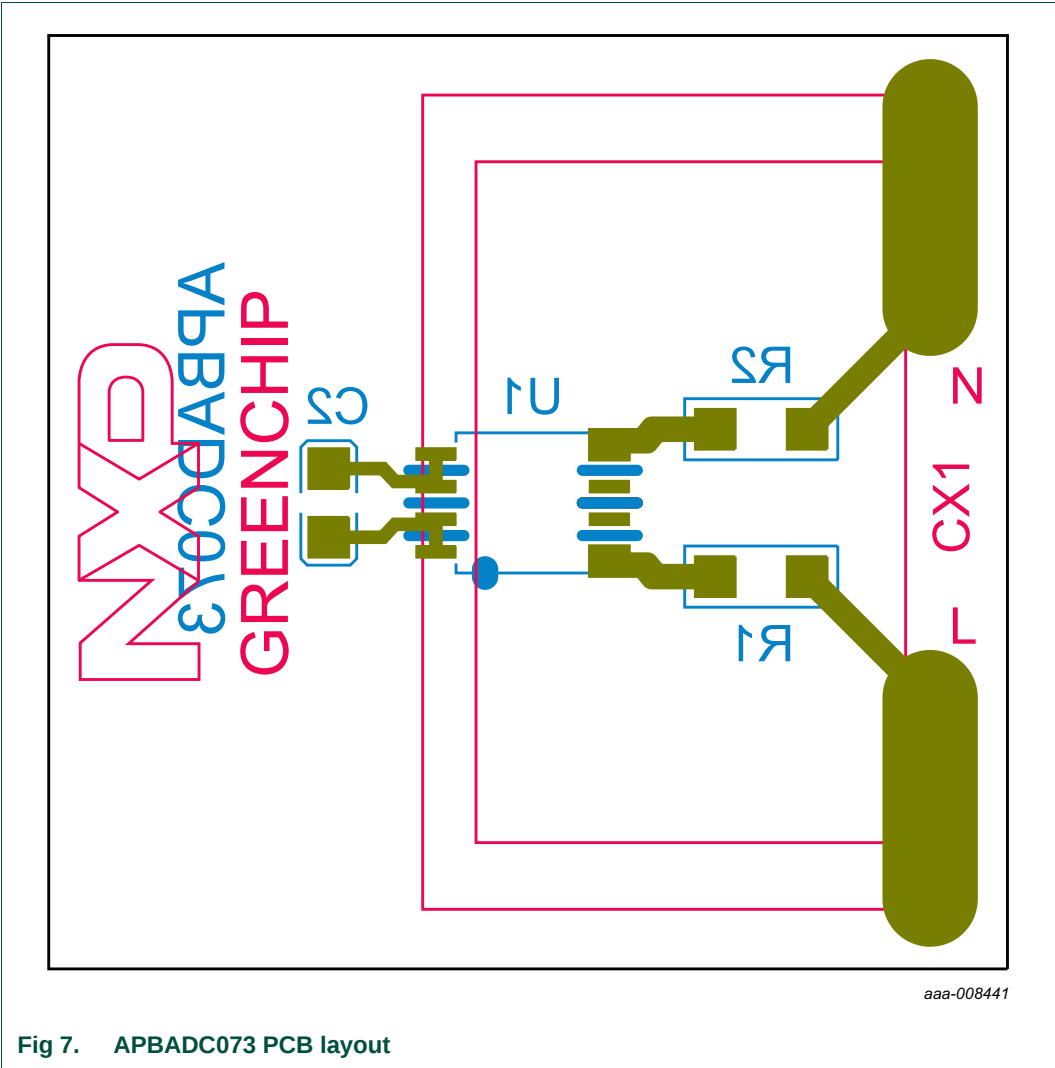
Surge voltage	R1, R2 (kΩ)	Result	Comments
1 kV/90 °	200	pass	230 V/50 Hz; differential L to N
2 kV/90 °	200	pass	230 V/50 Hz; differential L to N
4 kV/90 °	200	pass	230 V/50 Hz; differential L to N
6 kV/0 °	200	pass	230 V/50 Hz; differential L to N
6 kV/90 °	200	pass	230 V/50 Hz; differential L to N
6 kV/180 °	200	pass	230 V/50 Hz; differential L to N
6 kV/270 °	200	pass	230 V/50 Hz; differential L to N

7. Schematic



On the demo board, pin 1 (NC) and pin 2 (TMR2) are connected. Pin 3 (NC) and pin 4 (TMR1) are also connected. The reason for this is backward compatibility with earlier (test) versions of the TEA1708T.

For final application designs with the TEA1708T, leave pin 1 and pin 3 open. Connect capacitor C2 only to pin 2 (TMR2) and pin 4 (TMR1), as this eliminates the risk of malfunctioning as a result of accidentally soldering together two adjacent pins.



8. Bill Of Material (BOM)

Table 6. Bill of materials APBADC073 demo board

Reference	Description and values	Part number	Manufacturer
R1	resistor; 200 kΩ; 5 %; SMD; 1206	-	-
R2	resistor; 200 kΩ; 5 %	-	-
CX1	X2 capacitor; 1 μF; 275 V; Axial; MKP	-	-
C2	capacitor; 10 nF; 50 V; SMD; 0805; MLCC; X7R	-	-
U1	IC; TEA1708T	SO8	NXP Semiconductors

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