Battery low-level indicator

TEA1041T

FEATURES

- Optical signal following battery low-level detection
- Additional warning ('recharge needed') at end of system operation
- One or two LED indication
- Trigger level adjustable
- Low stand-by current
- Insensitive to interference
- Few external components

APPLICATIONS

- Battery operated systems

GENERAL DESCRIPTION

Intended for use with battery operated systems, the TEA1041T generates an optical alarm via one or two LEDs when the battery supply voltage falls below a preset threshold level.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
V_p	supply voltage	1.8	-	4.0	V
I_{sb}	stand-by current	-	-	10	µA
P_{tot}	total power dissipation	-	-	150	mW
I_L	output current LED outputs	-	-	59	mA

ORDERING INFORMATION

EXTENDED TYPE NUMBER	PACKAGE			
	PINS	PIN POSITION	MATERIAL	CODE
TEA1041T	8	SO8	plastic	SOT96A

FUNCTIONAL DESCRIPTION

Supply (pin 8)

The supply voltage, which may range from 1.8 to 4.0 V, is connected to pin 8.

Voltage sense input (pin 1)

Pin 1 is connected to a trigger circuit consisting of a trigger amplifier and a Schmitt trigger.

An up / down counter in the control and timing logic is enabled when the potential at pin 1 falls below 1.25 V. Unless this voltage increases above 1.25 V the counter will operate for approximately two seconds. When the voltage increases or the count is timed-out, the counter will then begin counting-down. The circuit is thus protected from any disturbance of less than two seconds duration. LED 1 becomes lit on the next occasion that for two seconds the potential on pin 1 is less than 1.25 V.

Following low level detection the circuit is de-activated by operation of S1. For a period of 4 seconds LEDs 1 and 2 will then each be alternately lit for a duration of approximately 500 ms.

LED 1 and LED 2 connections (pin 7, 6)

The cathodes of LEDs 1 and 2 must be connected respectively to pins 7 and 6. The circuit will also function with only LED 1 connected.

Oscillator capacitor connection (pin 4)

Circuit timing is provided by the internal oscillator, the frequency of which is determind by a capacitor connected to pin 4.

Forcing a current (max. 5 mA) into pin 4 permits direct monitoring of the trigger circuit at pins 6 and 7. When V_I is above 1.25 V, pin 7 will be LOW and pin 6 will be HIGH. Alternatively, when V_I is below the 1.25 V threshold level pin 7 will be HIGH while pin 6 will be rendered LOW. This feature facilitates easier circuit adjustment.

Pin 2 Test Pin

An external clock signal may be connected to pin 2 for test purposes. This may be used to shorten the test time (see also test and application information).

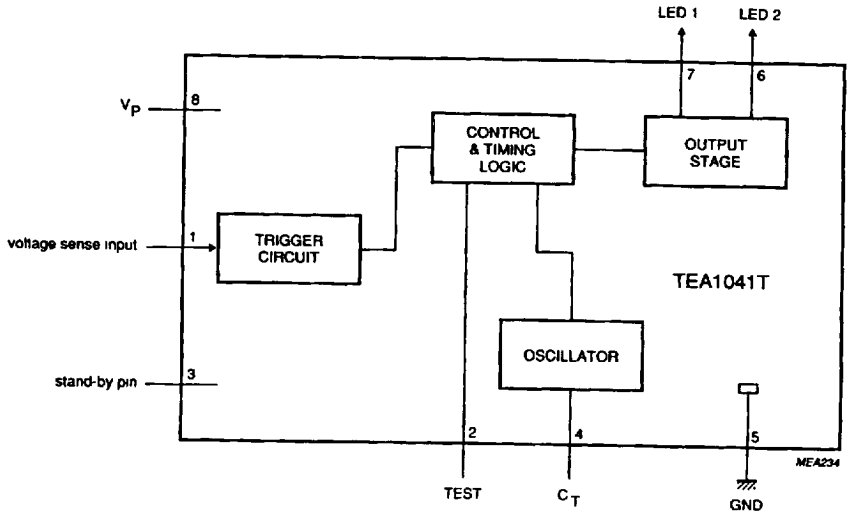


Fig.1 Block diagram.

PINNING

SYMBOL	PIN	DESCRIPTION
V_I	1	voltage sense input
TEST	2	test pin
V_{sw}	3	stand-by
C_T	4	oscillator capacitor
GND	5	ground
L2	6	LED 2
L1	7	LED 1
V_p	8	supply voltage

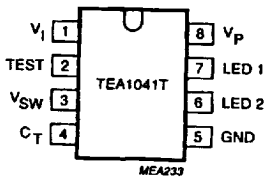


Fig.2 Pin configuration.

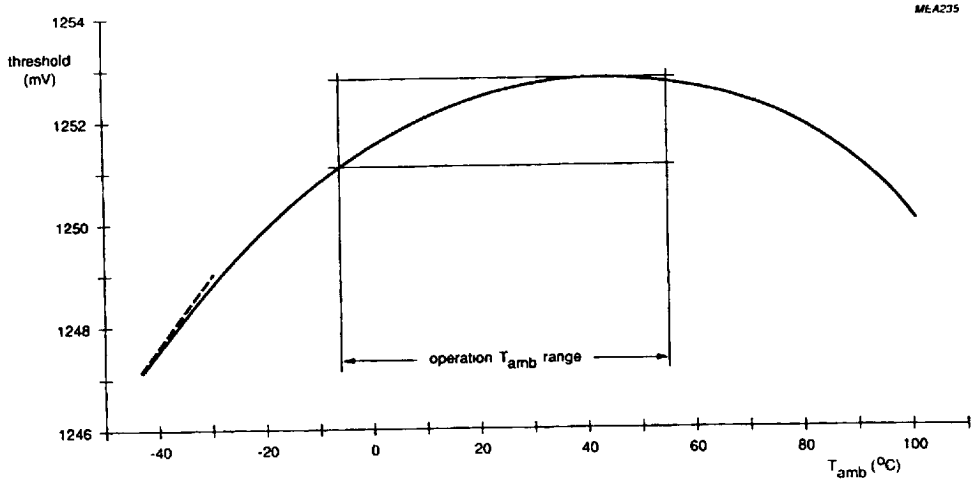


Fig.3 Thermal drift of the input threshold.

LIMITING VALUES

In accordance with the absolute maximum system (IEX 134)

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
T_j	junction temperature	−25	+125	°C
T_{stg}	storage temperature range	−25	+125	°C
V_{max}	maximum voltage (pins 1, 3 and 8)	−0.5	4	V
V_{max}	maximum voltage (pins 6 and 7)	−0.5	5.5	V
I_4	maximum current into pin 4	-	5	mA
	during 1 µs into V_p	-	90	mA
I_{max}	maximum current into test pin	-	0.5	mA
P_{tot}	total power dissipation	-	150	mW
T_{amb}	operating ambient temperature range	−5	+55	°C

Note

Voltages with respect to 0 V unless otherwise specified

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT.
R_{th}	thermal resistance	mounted on PC board	-	240	-	K/W
R_{th}		mounted on ceramic	-	170	-	K/W
R_{th}		mounted with heatsink on ceramic	-	120	-	K/W

CHARACTERISTICS

Voltages with respect to 0 V; $Tamb_{min}$ < Tamb < $Tamb_{max}$; V_{SW} = 0 V, V_p = 1.8 to 4.0 V; unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_p	supply voltage range		1.8	-	4	V
V_{cl}	clamp voltage V_p; V_{SW}, V_I	I = 10 mA	-	7.5	8.5	V
I_{SW}	supply current	V_p = 1.8 - 4 V	0 65	-	2.2	mA
I_p		V_p = 1.8 V; FF is not triggered	2.2	-	4.4	mA
I_p		V_p = 4 V; FF is triggered	4	-	8	mA
I_{sb}	stand-by current	measured 1 s after S1 is opened; V_p = 4 V	-	-	10	µA
Trigger amplifier T						
V_I	threshold	T_j = 25 °C	1.17	1.25	1.33	V
	temperature coefficient		−250	-	+250	10^{-6}/°C
ΔV_I	lifetime drift threshold level		-	1	-	mV/1000h
	hysteresis at input V_I due to Schmitt trigger		3	5	7	mV

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Timing circuitry						
t_{PLH}	propagation delay during adjustment	from passing threshold at input to 50% of output switching edge at I_O = 1 mA	-	1	10	µs
t_s	settling time of IC during adjustment		-	-	1	ms
f_{osc}	oscillator frequency	C = 10 nF; V_p = 2 to 2.8 V	5.7	8.2	10.7	kHz
I_c	required current I_c to switch adjusting circuitry		2.2	-	2.8	mA
Output circuit						
I_{L1}	output current	$V_{L1} = V_{LB2}$ = 0.5 V; V_p = 1.8 V	14	20	39	mA
I_{L2}		$V_{L1} = C_{L2}$ = 2.5 V V_p = 4 V	-	-	59	mA
ΔI_L	output current difference 100 $(I_{L1} - I_{L2} / (I_{L1} + I_{L2}) / 2)$		−15	-	+15	%
V_{sat}	output saturation voltage	I_{L1}; I_{L2} = 10 mA	-	-	200	mV
	output leakage current	$T_j \leq 55°C$; V_p = 4 V	-	-	10	µA
Test pin TP						
V_2	high voltage level	used as output	450	-	-	mV
V_2	low voltage level	used as output	-	-	150	mV
$+I_{TP}$	required input current high	used as input	300	-	-	µA
$-I_{TP}$	input current low	used as input	-	-	40	µA
f_{test}	maximum input frequency		10	-	-	kHz

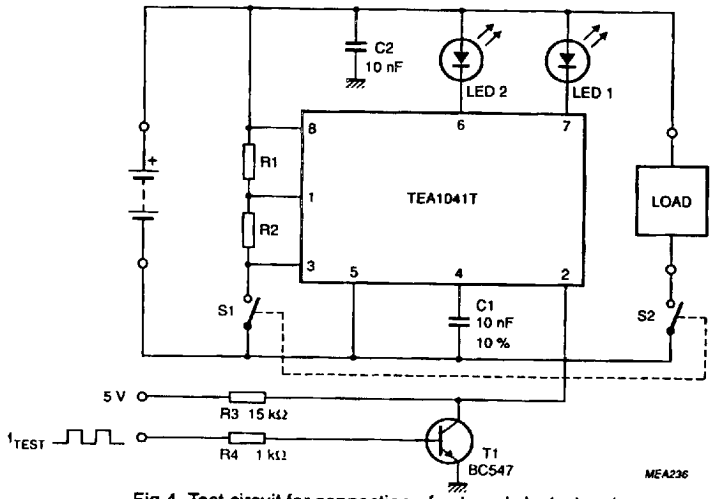


Fig.4 Test circuit for connection of external clock signal.

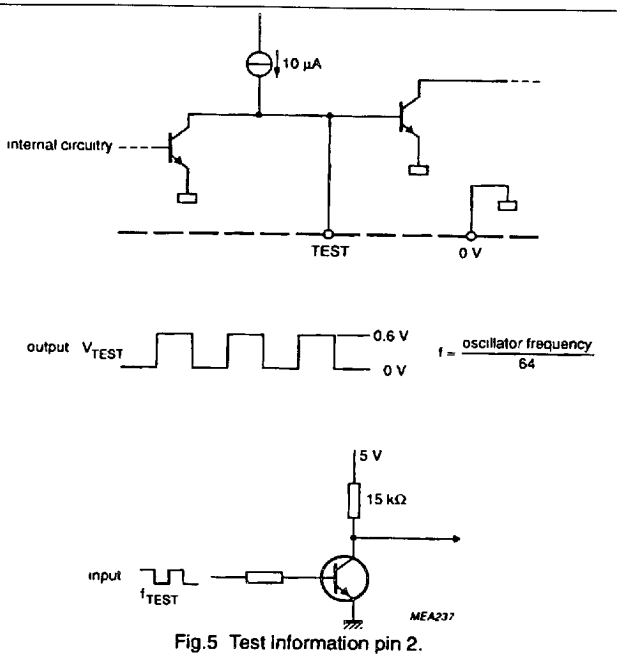


Fig.5 Test information pin 2.

Test information

The circuit depicted in Fig. 4 is that realized on the standard application PCB.

An external clock signal can be connected to pin 2 via a transistor. The oscillator frequency can be monitored when this pin is not in use.

Application information

The application circuit is simple and requires few external components.

A potential divider R1 - R2 is selected to permit achievement of the desired threshold level when the potential on pin 1 is 1.25 V. The sum of R1 and R2 should be approximately 2 kΩ.

To obtain an accurate oscillator frequency, the capacitor at pin 4 should be 10 nF ± 10%. If necessary an alternative value may be chosen to influence the timing.

LEDs such as the Philips PLED-H314A are the most suitable and should be capable of withstanding a forward current of at least 59 mA.

The application PCB was designed to permit use with or without an external load. In the latter instance S1 must be used to activate the battery monitor whilst S2 connects the load to its supply.

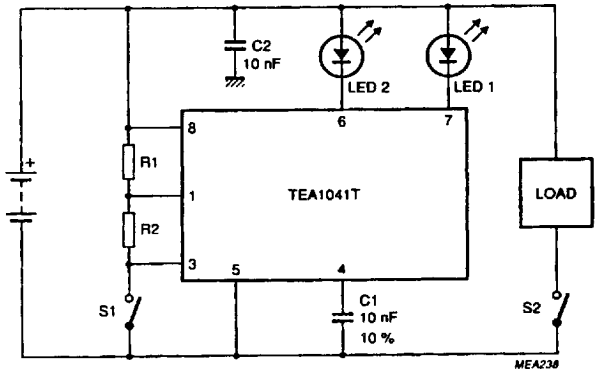
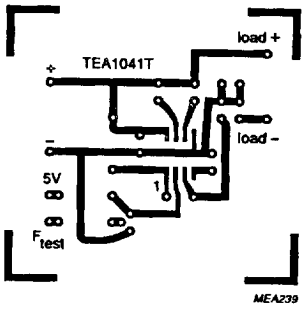


Fig.6 Application diagram.



Printed circuit board copper side, scale 2:1

Fig.7 Application PCB details.

APPLICATION CIRCUIT COMPONENT DETAILS

REFERENCE	TYPE	VALUE	UNIT
R1 + R2	-	±2	kΩ
R3	-	15	kΩ
R4	-	1	kΩ
C1	-	10 ±10%	nF
C2	-	10	nF
LED1, LED2	PLED-H314A	-	-
T1	BC547	-	-

Note

The TEA1041 must be soldered to the copper side of the printed-circuit board.