



# Ultimaker UMO Cooling fan PWM Ultimainboard transistor BC817 Replacement

Repair your own Ultimainboard (rev 2.1.1) PWM cooling fan T1 / T2 (type BC 817).

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# KEC

## SEMICONDUCTOR TECHNICAL DATA

### BC817

#### EPITAXIAL PLANAR NPN TRANSISTOR

GENERAL PURPOSE APPLICATION.  
SWITCHING APPLICATION.

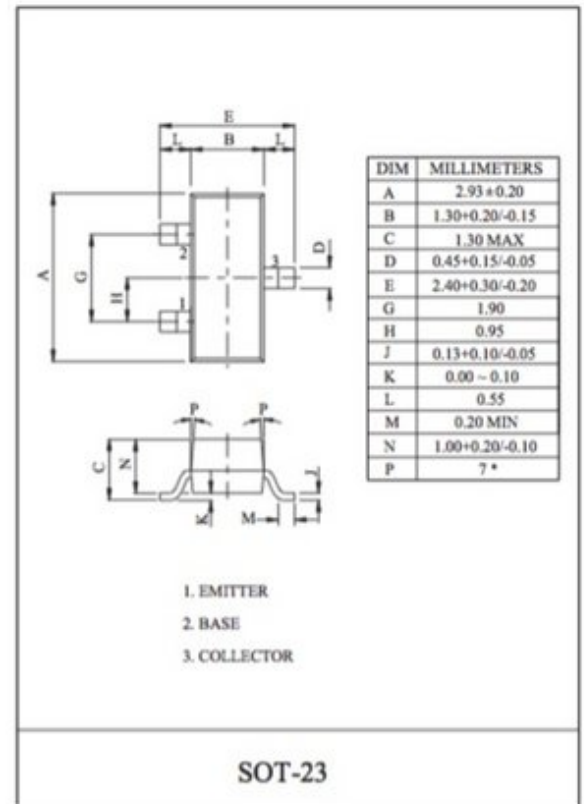
#### FEATURES

- Complementary to BC807.

#### MAXIMUM RATING (Ta=25℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	$V_{CBO}$	50	V
Collector-Emitter Voltage	$V_{CEO}$	45	V
Emitter-Base Voltage	$V_{EBO}$	5	V
Collector Current	$I_C$	800	mA
Emitter Current	$I_E$	-800	mA
Collector Power Dissipation	$P_C^*$	350	mW
Junction Temperature	$T_j$	150	℃
Storage Temperature Range	$T_{stg}$	-55 ~ 150	℃

\* : Package Mounted On 99.9% Alumina 10 × 8 × 0.6mm.



## INTRODUCTION

Different reasons leading to the PWM T1 or T2 failure, here is a guide to replace the transistor.

This guide is a fast-guide for makers. No transistor or electronics knowledge needed, hence the job can be done very quickly if parts are available. This can save you in the area of \$100-\$150 for replacing the whole mainboard.

The issue is addressed here:

<https://ultimaker.com/en/community/11366...>

The mainboard schematics are stored here:

<https://github.com/Ultimaker/Ultimaker-O...>



### TOOLS:

- [Soldering Iron](#) (1)
- [Soldering Tweezers](#) (1)



### PARTS:

- [Transistor BC718 e.g. 6C NPN SOT-23](#) (1)

Step 1 — Prepare tools and order replacement parts

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MAXIMUM RATING (Ta=25℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V <sub>CB0</sub>	50	V
Collector-Emitter Voltage	V <sub>CE0</sub>	45	V
Emitter-Base Voltage	V <sub>EB0</sub>	5	V
Collector Current	I <sub>C</sub>	800	mA
Emitter Current	I <sub>E</sub>	~800	mA
Collector Power Dissipation	P <sub>C</sub> *	350	mW
Junction Temperature	T <sub>j</sub>	150	℃
Storage Temperature Range	T <sub>stg</sub>	-55 ~ 150	℃

\* : Package Mounted On 99.9% Alumina 10 × 8 × 0.6mm.

DIM. MILLIMETERS

A	2.93 ± 0.20
B	1.30 ± 0.20 ± 0.15
C	1.30 MAX.
D	0.45 ± 0.15 ± 0.05
E	2.40 ± 0.30 ± 0.20
G	1.90
H	0.95
J	0.13 ± 0.10 ± 0.05
K	0.00 ~ 0.10
L	0.15
M	0.20 MIN.
N	1.00 ± 0.20 ± 0.10
P	1*

1. EMITTER  
2. BASE  
3. COLLECTOR

SOT-23

ELECTRICAL CHARACTERISTICS (Ta=25℃)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I <sub>CBO</sub>	V <sub>CB</sub> =20V, I <sub>E</sub> =0	-	-	0.1	μA
Emitter Cut-off Current	I <sub>EB0</sub>	V <sub>EB</sub> =5V, I <sub>C</sub> =0	-	-	0.1	μA
DC Current Gain (Note)	h <sub>FE</sub> (1)	V <sub>CE</sub> =1V, I <sub>C</sub> =100mA	100	-	630	
	h <sub>FE</sub> (2)	V <sub>CE</sub> =1V, I <sub>C</sub> =500mA	40	-	-	
Collector-Emitter Saturation Voltage	V <sub>CE(sat)</sub>	I <sub>C</sub> =500mA, I <sub>B</sub> =50mA	-	-	0.7	V
Base-Emitter Voltage	V <sub>BE</sub>	V <sub>CE</sub> =1V, I <sub>C</sub> =500mA	-	-	1.2	V
Transition Frequency	f <sub>T</sub>	V <sub>CE</sub> =5V, I <sub>C</sub> =10mA, f=100MHz	100	-	-	MHz
Collector Output Capacitance	C <sub>ob</sub>	V <sub>CB</sub> =10V, I <sub>E</sub> =0, f=1MHz	-	5	-	pF

Note : h<sub>FE</sub>(1) Classification 16:100 ~ 250 , 25:160 ~ 400 , 40:250 ~ 630

MARK SPEC

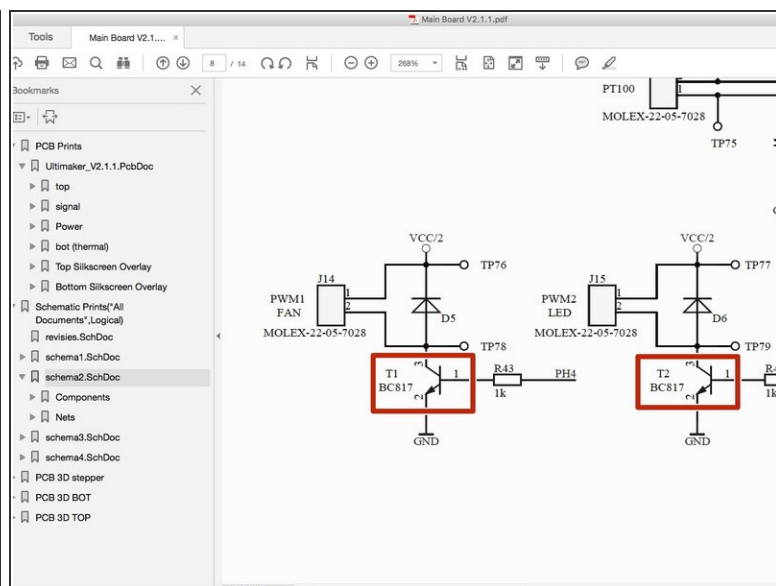
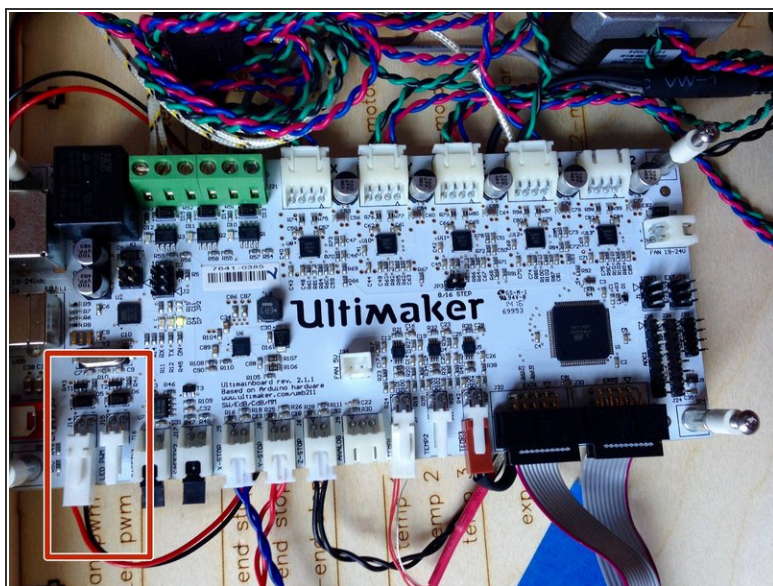
TYPE	BC817-16	BC817-25	BC817-40
MARK	6A	6B	6C

Marking

Type Name      Lot No.

- Prepare your workspace, tools, etc. this is important due to the challenges faced in handling [SMD electronic](#) parts. Decent light conditions, non-static environment, etc. A SMD Soldering guide link is given on step 2 and 3.
- It is recommended to purchase a batch of transistors (say 5-10) for different reasons: The failure might happen again, SMD parts are very delicate in handling, because you love transistors, etc.
- Note: If you cannot find a BC817 replacement say at Mouser, Digikey, etc. [this transistor from KEC provided by Conrad DE is confirmed as working](#)
- Note: If you do not have any electronics soldering equipment, take a look at this [starter kit](#) or for [Europe \(Germany\) try this set](#).

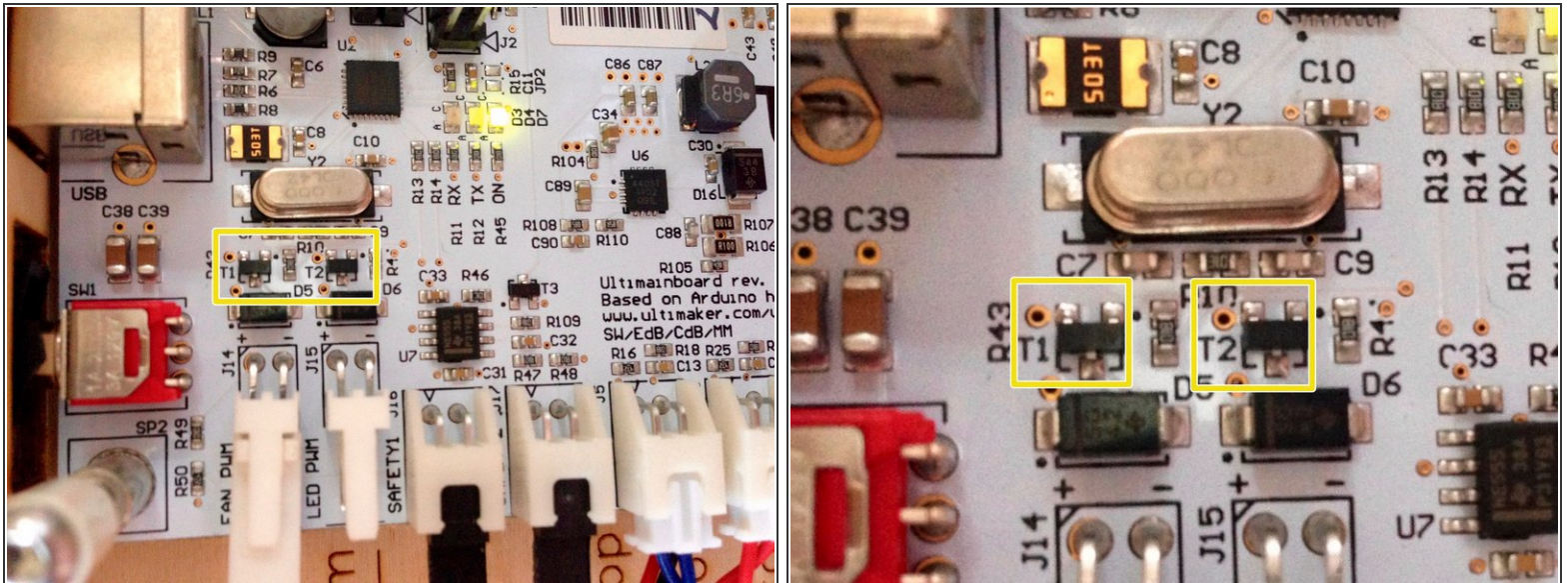
## Step 2 — Locate the issue



- Locate the affect transistor (Channel PWM 1 or 2)
- Note: This is a quick guide. It makes the assumption that the transistor is dead no matter what. This guide does not provide analysis and help on NPN transistors as it is not needed for getting the fan back to work.
- Before you continue, you might want to read on SMD soldering from different sources (iFixit or see the provided [On Semi guide on SMD](#), which looks very comprehensive or [Sparkfun's Guide can be highly recommended](#)) and plan time if you haven't got the environment already setup



### Step 3 — Replace the old with the new (soldering)



- Disconnect all power connections before you start and get anti-static. No warranty!
- Have the replacement transistor ready for deployment
- Heat up the soldering iron (350-400°C or 700°F should be right depending on your lead, iron welder, etc.); avoid temperatures that are far above melting due to the sensitivity of SMD devices, see also the [On Semi guide](#) or [Sparkfun's SMD Soldering Guide](#)
- Remove the broken transistor by carefully heating the SMD pads that connect T1 (or T2) to the mainboard PCB. Because there are three pads, try circular rotation while using tweezers to pull of the broken device
- Use the solder suction pump to remove any old solder around the transistor pads
- Note: This guide is assuming that the NPN transistor has the following pinning (SOT-23): TOP LEFT: Emitter TOP RIGHT: Base BOTTOM: COLLECTOR, see the data sheet and mainboard picture. Nothing too much can go wrong here, as the pads are given in direction.
- Finally, solder the new transistor onto the pads. If you face difficulty with handling the device, tweezers, etc. try [electronics magnifying glasses](#) -- Ultimately, check the output voltage according to the software setting (PWM 255 steps) or just connect the fan hopefully it now works again!

If you rely on PWM1 and 2 working, this guide will sort out the transistor issue in no time.