Cost Estimate

This document aims to estimate all the costs involved in producing the Tiny Scarab board, its enclosure and graphical overlay membrane.

# 1. PCB Circuit

## 1.1 Component Cost

I purchase all components – except for one – directly at the circuit manufacturer JLC PCB. I typically buy the components before ordering the PCB itself. They are stored in my personal inventory in the JLC PCB factory (each client has an account and a personal inventory tied to that account, where you can pre-order components).

These are the components I order for one board:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Designators** | **JLCPCB Part #** | Qty | **$/part** | **$/board** |
| C1, C2, C4, C5, C6, C7, C8, C9, C10, C15, C16, C17, C23, C24, C25, C26, C27, C30, C31, C37, C38, C39, C40, C41 | C307331 | 24 | 0.004500 | 0.108000 |
| C3, C20, C21, C22, C32, C33, C34, C35, C36 | C15850 | 9 | 0.008100 | 0.072900 |
| C11, C13, C14, C18 | C52923 | 4 | 0.003600 | 0.014400 |
| C12, C19 | C15525 | 2 | 0.004700 | 0.009400 |
| C28, C29, C42, C43 | C1555 | 4 | 0.000900 | 0.003600 |
| D1 | C2943833 | 1 | 0.021000 | 0.021000 |
| D2 | C397613 | 1 | 0.016400 | 0.016400 |
| F1 | C1972777 | 1 | 0.086600 | 0.086600 |
| J1 | C2927038 | 1 | 0.037800 | 0.037800 |
| J3, J4 | C84004 | 2 | 0.048200 | 0.096400 |
| LED1, LED5 | C7115899 | 2 | 0.320900 | 0.641800 |
| LED2 | C5579175 | 1 | 0.398200 | 0.398200 |
| LED3, LED4 | C6538602 | 2 | 0.531400 | 1.062800 |
| Q1, Q2, Q6 | C156390 | 3 | 0.017700 | 0.053100 |
| Q3, Q4, Q5 | C177033 | 3 | 0.077600 | 0.232800 |
| R1, R27 | C25117 | 2 | 0.000500 | 0.001000 |
| R2 | C25087 | 1 | 0.000500 | 0.000500 |
| R4, R13, R19, R29, R31 | C11702 | 5 | 0.000500 | 0.002500 |
| R5, R6 | C25905 | 2 | 0.000500 | 0.001000 |
| R7, R15, R17 | C25076 | 3 | 0.000500 | 0.001500 |
| R8, R10 | C25091 | 2 | 0.000500 | 0.001000 |
| R14, R25, R26, R32 | C25741 | 4 | 0.000500 | 0.002000 |
| R16, R18 | C25092 | 2 | 0.000500 | 0.001000 |
| R20, R21, R28 | C25744 | 3 | 0.000500 | 0.001500 |
| R22, R23, R24 | C17168 | 3 | 0.000500 | 0.001500 |
| SW1, SW2, SW3 | C92581 | 3 | 0.064500 | 0.193500 |
| SW4 | C2884764 | 1 | 0.076500 | 0.076500 |
| SW5 | C146695 | 1 | 0.057200 | 0.057200 |
| TVS1, TVS2 | C840637 | 2 | 0.352500 | 0.705000 |
| TVS3 | C83329 | 1 | 0.082400 | 0.082400 |
| TVS4, TVS5, TVS6, TVS7, TVS8, TVS9, TVS10, TVS11, TVS12, TVS13, TVS14, TVS15, TVS16, TVS17, TVS18, TVS19, TVS20, TVS21, TVS22, TVS23, TVS24, TVS25, TVS26, TVS27, TVS28, TVS29, TVS30, TVS31, TVS32, TVS33, TVS34, TVS35 | C126836 | 32 | 0.052100 | 1.667200 |
| U1 | C500761 | 1 | 0.152400 | 0.152400 |
| U2 | C145411 | 1 | 1.024500 | 1.024500 |
| U3 | C5123443 | 1 | 1.542000 | 1.542000 |
| XTAL1 | C2901629 | 1 | 0.192300 | 0.192300 |
| XTAL2 | C279615 | 1 | 0.103700 | 0.103700 |

The $/part column is filled in in the assumption that I purchase a large enough quantity of parts to fill 100 PCBs. In other words, the “bulk discount” is already integrated in the price.

Adding all the component prices from the aforementioned table results in $8.6654 component cost per board.

Add to that the CH32V003F4P6 10-cent microcontroller that I cannot order at JLC PCB. Only distribution channel for this chip is AliExpress. The microcontroller itself is dirt cheap, but I need to pay of course the transport and transaction costs. So the eventual component cost is:

**$9.00** component cost per board, if order quantity is > 100



## 1.2 PCB Production and Assembly Cost

I’ve listed the PCB production and assembly (parts placement and soldering) costs in the table below. Please note that these costs are under the assumption that >100 PCBs are ordered:

|  |  |  |
| --- | --- | --- |
|  | $/board | Notes |
| PCB Production | 0.6703 |  |
| Board clean service | 0.1650 |  |
| PCB Assembly | 1.3622 |  |
| Additional solder cost | 0.2950 | I’m not entirely sure what the “additional solder cost” refers to. I believe it’s related to some manual actions needed to prepare the machines etc. |
| Shipping cost | 1.3559 | Shipping cost per board can decrease for larger quantities. |
| Customs duties & taxes | 1.9201 | Not sure how JLCPCB computed this. I’ve sent a mail to request further info. I think it’s the 21% VAT cost for both the board production as well as the component purchases. |

The total cost per board:

**$5.7685** board production cost :

* Includes component assembly
* Excludes component purchase (that’s already accounted for in previous section)
* Includes shipping and taxes
* Assume order quantity > 100



The shipping cost goes slightly up for larger quantities, but not linearly. So the shipping cost per board can be reduced by ordering larger quantities that are shipped in one batch.

# 2. Enclosure

The following table lists the costs for the enclosures, provided that the order quantity > 100:

|  |  |  |
| --- | --- | --- |
|  | $/unit | Notes |
| Box | 3.2862 |  |
| Lid | 0.9431 |  |
| Shipping | 2.1536 |  |
| Customs duties & taxes | 1.3405 | Seems to be 21% VAT tax |

**$7.7234** enclosure production cost :

* Includes shipping and taxes
* Assume order quantity > 100



Again, the shipping cost goes slightly up for larger quantities, but not linearly. So the shipping cost per unit can be reduced by ordering larger quantities.

# 3. Graphical Membrane

The graphical membrane costs $1.45 per unit, for >100. The shipping fee is not given separately.

**$1.45** graphical membrane cost :

* Includes shipping
* Includes taxes (?)
* Assume order quantity > 100



# 4. Miscellaneous Costs

The finished product has 5 light pipes to funnel the LED lights to the surface. Four screws need to be inserted to fasten the enclosure. Last but not least – I place a small iron block in each enclosure to give the product extra weight, such that it sits stable on the desk when attached to wires.

|  |  |  |
| --- | --- | --- |
|  | $/unit | Notes |
| Light Pipes | 0.31 x 5 = 1.55 (excl. VAT)  1.55 x 1.21 = 1.8755 (incl. VAT) | 12 weeks delivery time, so I have to order them from a more expensive source at 0.80$ a piece if needed faster |
| Screws | 0.02 x 4 = 0.08 |  |
| Iron block | 1.198 (incl. VAT) | Includes shipping cost and VAT tax |

**$3.1535** miscellaneous costs :

* Includes shipping and taxes
* Assume order quantity > 100



# TOTAL

Let’s compute the total cost per unit (incl shipping and taxes):

|  |  |
| --- | --- |
|  | $/unit  (incl shipping and taxes) |
| PCB components | 9.0000 |
| Board Production | 5.7685 |
| Enclosure | 7.7234 |
| Graphical Membrane | 1.4500 |
| Miscellaneous | 3.1535 |
|  |  |
| TOTAL | **27.0954** |

The total cost per unit, if produced in > 100 quantities, is **$27.0954**. This includes all shipping and taxes. Without shipping and taxes, the total cost per unit would be **$19.5942**.