
LCM3C and LCM3T

User Guide

1 MP3 Development Platform

1.1. MP3 layout and interfaces

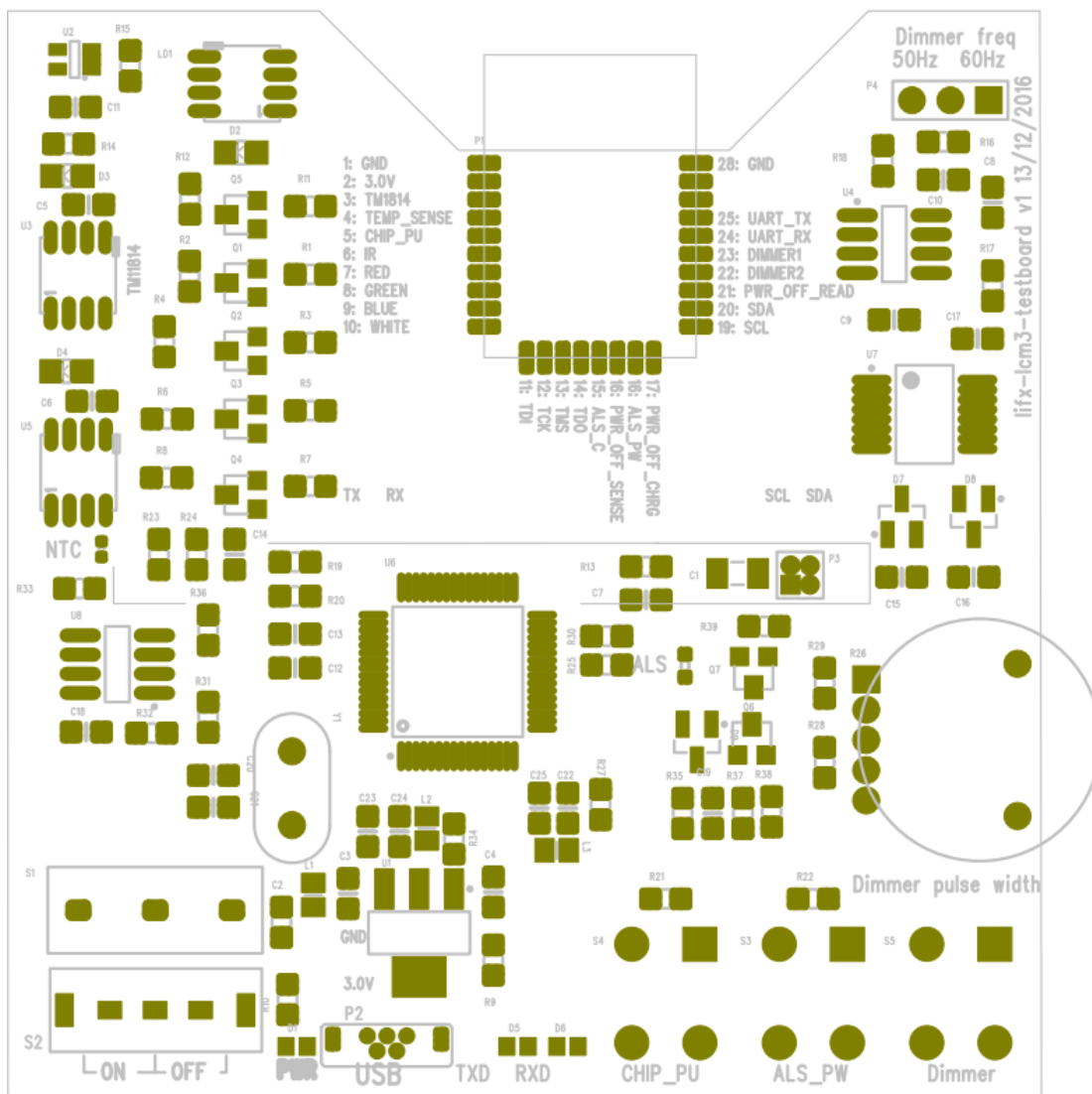


Figure 1-1 Front view of the LCM3/LCM3T development platform

Table 1-1 MP3 components

S1,S2	Input Power Switch	S3	SW state for ALS PW
S4	For CHIP PU	S5	For Dimmer
S5	Reset for TLC555	P1	LCM3 module

P2	USB2.0 socket with 5V power input	P3	MFI daughter board header
P4	Jumper for selecting dimming frequency, open:50Hz, Close:60Hz	U1	Voltage Regulator LM1117
U2	TM1814 Logic Translator, 74AHCT1G125SE	U3, U5	TM1814, RGBW LED with SPI-mode LED driver IC on
U4	TLC555	U6	FT2232HL USB-RS232
U7	74HCT221	U8	M93CxS, E2PROM
D1	LED for indicator of 3.0V power	D2, Q5	IR LED and its driver MOS
LD1	RGBW LED IC	Q1~Q4	MOS driver for RGBW LED
LDR1	Ambient Light Sensor	Q7	2N7002K, MOS for control Q6
Q6	SSF6007, MOS for ADC power off time sense	R26	Variant Resistor

1.2. MP3 functionality

This section lists the power supply, jumper settings, push button, headers interfaces and their pin assignments.

Table 1-2 Power supply

Component	Definition and description
P2	Mini-USB interface, for ART and power supply
S1,S2	Input Power Switch

Table 1-3 Header interfaces

Header	Pin no.	Function1	Function2	Function3	Function4	ESP32 GPIO no.
P1	P1.1 P1.28	Ground				
	P1.2	3.3V Power				GPIO[13]
	P1.3	32.768k crystal positive input				GPIO[12]
	P1.4	32.768k crystal negative input				
	P1.5	CHIP PU				GPIO[10]
	P1.6	VDET_1	I2C slave data			GPIO[11]
	P1.7	VDET_2				
	P1.8	GREEN PWM				GPIO[25]
	P1.9	BLUE PWM				GPIO[26]
	P1.10	WHITE PWM				GPIO[27]

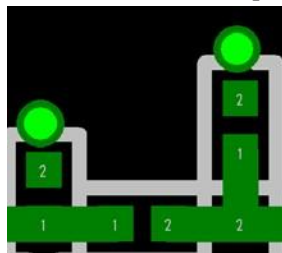
P1.11	MTDI				
P1.12	MTCK				
P1.13	MTMS				
P1.14	MTDO				
P1.15	RED PWM				GPIO[2]
P1.16	IR				GPIO[4]
P1.17	RUN MODE				
P1.18	Power off time charge control				GPIO[5]
P1.19	SCL				
P1.20	SDA				
P1.21	Power time read control				GPIO[22]
P1.22	Dimmer2				GPIO[19]
P1.23	Dimmer1				GPIO[21]
P1.24	UART_RX				
P1.25	UART_TX				
P1.26 P1.27	NC				

2 PCB Design Guidelines

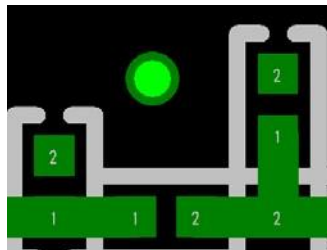
2.1. GND

2.1.1. Placement of capacitor shunted to GND

- Place bypass capacitors as close to the respective pins as possible.
- Place at least one dedicated ground via for each capacitor shunted to ground and put ground via as close to the capacitors as possible.



Good capacitor placement (2 capacitors with 2 dedicated ground vias)



Bad capacitor placement (2 capacitors sharing only 1 ground via)

2.1.2. GND

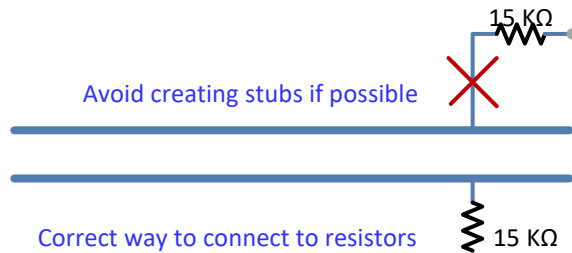
Avoid large ground planes without ground vias. The ground plane shown in [Figure 2-1](#) can act like an antenna radiating unwanted signals to other parts of the reference board.



Figure 2-1 Ground plane without ground vias

USB

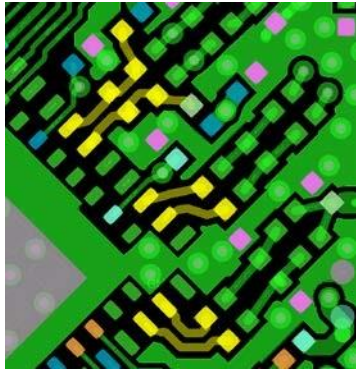
- Use $90\ \Omega$ differential lines to rout USB D+/D-.
- Avoid routing USB lines close to the edge of the board.
- Avoid routing USB lines with 90° turns. Use 45° transition.
- Avoid placing stub components on the USB data lines.



RF design for Wi-Fi modules

This section is more related to the Wi-Fi modules, LCM3, than to the RB01.

- Route all differential and single-ended traces for RF signal with an impedance of $50\ \Omega$. Avoid right angle line routing. Espressif recommends all RF components and traces to be on the same side of the board.
 - Must not rout any trance under the LCM3 module except of GND.
 - Avoid vias as much as possible in the RF traces. Do not use any test points on any RF traces or component.
 - Minimize the length of all RF traces since FR4 material incurs losses at RF frequencies. Minimizing the trace length reduces the overall signal loss. If there are different Tx path and Rx path, Keeping the Tx path short is more important than keeping the Rx path short.
 - If there are different Tx path and Rx path, a loss in signal strength in the Tx path cannot be recovered, but the Rx signal can be amplified on-board, to compensate for loss.
 - Do not put metal under the U.FL connectors on layer 1. Make sure that the ground is present on all other layers of the board.
 - Keep the length of the RF differential output traces as short as possible.
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- Use separate vias to tie all the power pins to the power traces or power plane. Do not make the power pins share the same VDD via.



- Avoid power trace routing underneath the ESP32.
- Enclose the crystal traces with ground plane and avoid routing power traces underneath the crystal.

Board stack-up

The MP3 is implemented on a two-layer board:

- Layer 1 is for signal traces.
- Layer 2 is mainly ground plane.

The MP3 is comprised of the elements listed in this section, with the board stack-up as shown in [Figure 2-2](#).

- 2-layer board
 - Total stack thickness: 63 mil/1.6 mm
 - Material: FR4 Tg 140
 - Impedance @ 2.4 GHz: 50 Ω
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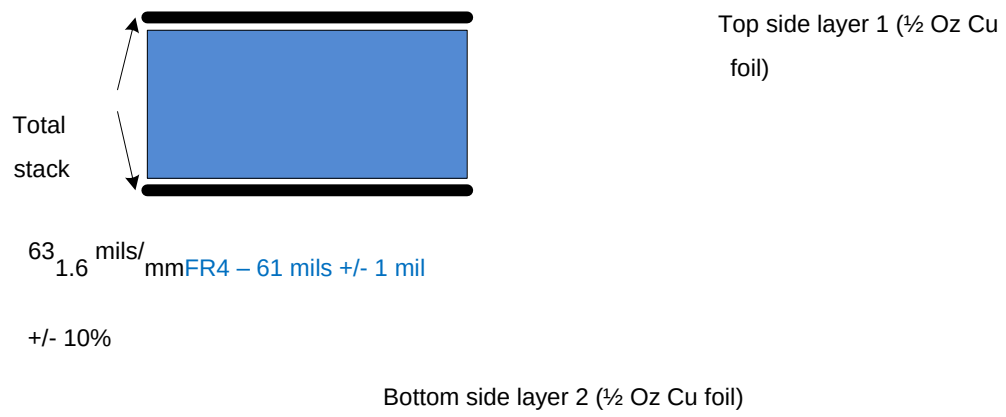


Figure 2-2 MP3 board stack-up

3 Statement of use

Operating conditions

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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 radiofrequency 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.
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RF Warning Statement

To comply with FCC RF exposure compliance requirements, the antennas used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter. This device is intended only for OEM integrators under the following conditions:

- 1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
- 2) The transmitter module may not be co-located with any other transmitter or antenna.

As long as two conditions above are met, further transmitter test will not be required as something related to RF exposure. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed. To ensure compliance with all non-transmitter functions the host manufacturer is responsible for ensuring compliance with the module(s) installed and fully operational. For example, if a host was previously authorized as an unintentional radiator under the Declaration of Conformity procedure without a transmitter certified module and a module is added, the host manufacturer is responsible for ensuring that after the module is installed and operational the host continues to be compliant with the Part 15B unintentional radiator requirements. The module is limited to OEM installation ONLY. The module is limited to installation in mobile or fixed application. We hereby acknowledge our responsibility to provide guidance to the host manufacturer in the event that they require assistance for ensuring compliance with the Part 15 Subpart B requirements.

IMPORTANT NOTE: In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for reevaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

End Product Labeling

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: "Contains FCC ID: 2AA53-LCM3 and IC: 11475A-LCM3". The grantee's FCC ID and IC Number can be used only when all FCC and ISED compliance requirements are met. The following FCC part 15.19 statement has to also be available on the label: This device complies with Part 15 of 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.

Installation Guideline

Antenna information

WiFi antenna: PCB antenna and max gain 1.9dBi

Manual Information to the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

In the user manual of the end product, the end user has to be informed that the equipment complies with FCC radio-frequency exposure guidelines set forth for an uncontrolled environment. The end user has to also be informed that any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment. The end user manual shall include all required regulatory information/warning as show in this manual.

This device complies with Part 15 of the FCC Rules and with RSS-247 of Industry Canada. 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.

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.

Radiation Exposure Statement:

This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

Déclaration d'exposition aux radiations:

Cet équipement est conforme aux limites d'exposition aux rayonnements IC établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps.