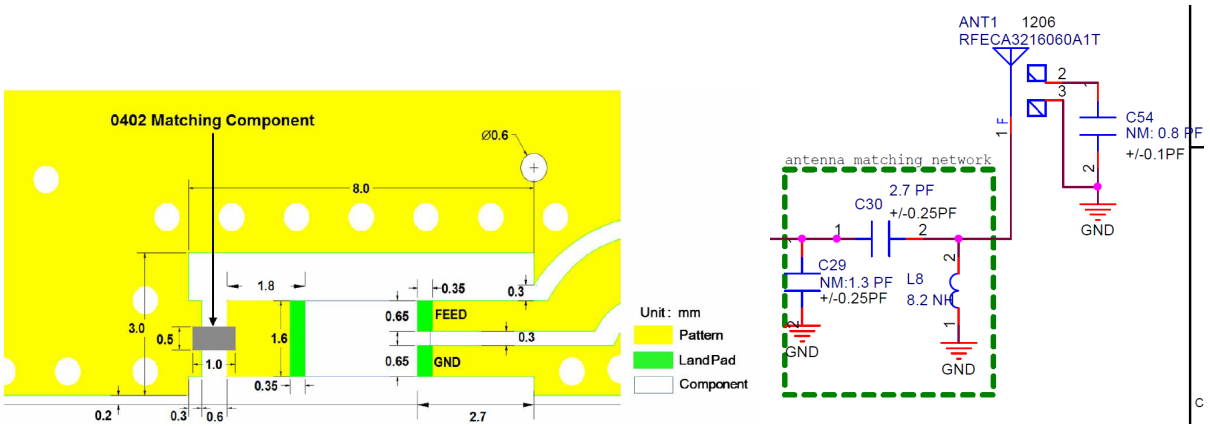
TEST REPORT

GENERAL INFORMATION

MANUFACTURER:	Logitech Europe S.A.
MODEL NAME:	YR0087
MEASUREMENT LAB:	Logitech Suzhou EE LAB
TEST DATE:	2022/11/27~2022/12/7
TEST PERSONNEL:	Damin Chiu

1. LTCC chip antenna reference design

The LTCC chip antenna could offer needed RF performance for the wireless keyboard. Reference design as shown below. The RF performance would be checked in each project, and all sizes and matching values needed to be fine tuned accordingly, as the real RF performance could be impacted by PCB layout (GND plane), membrane, metal-plate, cases and cables, which are different in each project.



- LTCC chip antenna PN: [ASC_RFECA3216060A17L2T_V01]
    - supplier provide the spec from the demo board

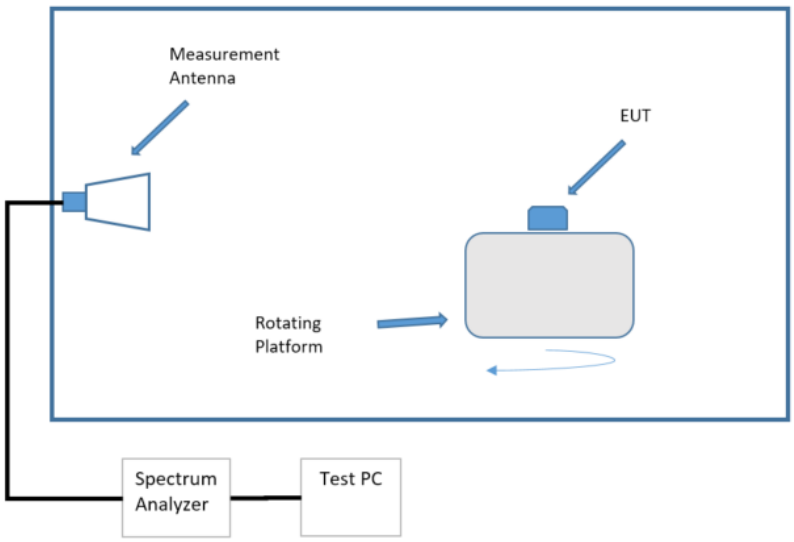
Item	Specification
Working Frequency Range	2.4GHz~2.4835GHz (Note-1)
Gain	2 dBi (Typical)
VSWR	2.0 max.
Polarization	Linear
Azimuth Beamwidth	Omni-directional
Impedance	50Ω
Power Capacity	3 W max.
Maximum Input Power	5 Watts for 5 minutes

- Antenna keepout size: length = 8mm; width = 3mm
- L8,C29,C30,C54 are Antenna matching components, ref. value: C30=3.9nH,L8,C29 and C54 are not mounted.
- All sizes and components values could be fine tuned in each project based on the real RF performance.

2. Test setup

2.1 Test description

- Controlling software(RF sample with Receiver[Number lock]) has been activated to set the EUT on specific status



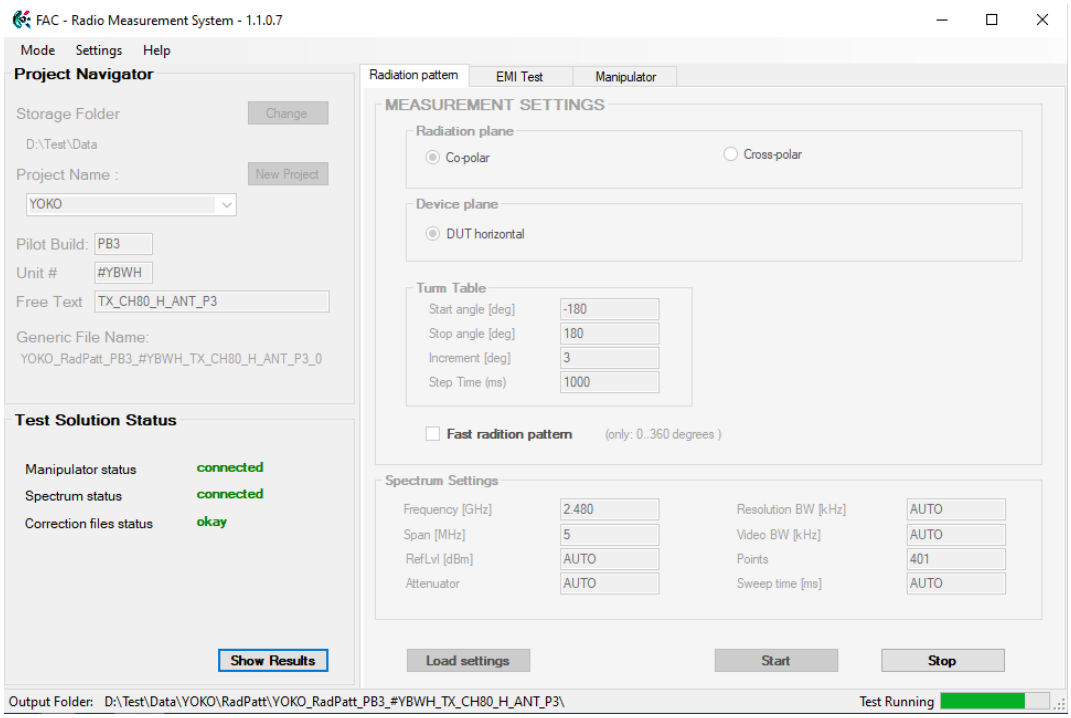
2.2 Test setup

2.3 Table of calibrated equipment

Description	**CALIBRATION DUE DATE**
FAC 2.4GHz Chamber	N/A
Measurement Horn Antenna (SZ)	2024.07.22
Spectrum Analyser, Keysight N9010A	2023.07.14
Dell Optiplex 745	N/A

2.4 Test software

- based on Logi SW named FAC-Radio Measurement System


FAC - Radio Measurement System - 1.1.0.7
Mode
Settings
Help
Project Navigator
Storage Folder
Change
D:\Test\Data
Project Name :
New Project
YOKO
Pilot Build:
PB3
Unit #
#YBWH
Free Text
TX_CH80_H_ANT_P3
Generic File Name:
YOKO_RadPatt_PB3_#YBWH_TX_CH80_H_ANT_P3_0
Test Solution Status
Manipulator status
connected
Spectrum status
connected
Correction files status
okay
Show Results
Radiation pattern
EMI Test
Manipulator
MEASUREMENT SETTINGS
Radiation plane
Co-polar
Cross-polar
Device plane
DUT horizontal
Turn Table
Start angle [deg]
-180
Stop angle [deg]
180
Increment [deg]
3
Step Time (ms)
1000
Fast radition pattern
(only: 0..360 degrees)
Spectrum Settings
Frequency [GHz]
2.480
Span [MHz]
5
RefLvl [dBm]
AUTO
Attenuator
AUTO
Resolution BW [kHz]
AUTO
Video BW [kHz]
AUTO
Points
401
Sweep time [ms]
AUTO
Load settings
Start
Stop
Output Folder: D:\Test\Data\YOKO\RadPatt\YOKO_RadPatt_PB3_#YBWH_TX_CH80_H_ANT_P3\
Test Running

2.5 Test procedure

For conducted power

A spectrum analyzer was used to perform output power measurement, setting the detector to normal and configuring EUT continuously transmitting power(100% duty cycle).

For radiation power

i. Connect the EUT to Spectrum Analyzer and record the power setting of EUT and the measured conducted power.
ii. Fasten the EUT in the center of the turntable, record the coordinates and take pictures.
iii. Configuring EUT continuously transmitting power(100% duty cycle).
iv. Make sure the transmit signal is stable and at the maximum RF power level.
v. Setup the channel power function by spectrum analyzer.
vi. Read the channel power level on the spectrum analyzer and record in the following positions.
    1. The turntable is then stepped between 0 to 360 degrees along the horizontal plane in 15-degree increments.
    2. Data is recorded using the spectrum analyzer for both theta and phi polarizations at each position.
vii. Antenna Peak Gain (dBi) = Max EIRP(dBm) - Conducted Power (dBm)

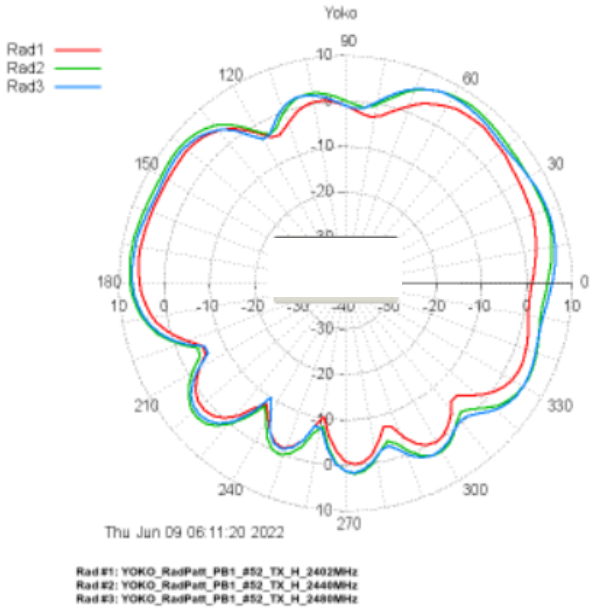
3. LTCC chip Antenna in Yoko KBD project

3.1 Radiation pattern and Antenna gain

Table below shows conducted power and EIRP, antenna gain = EIRP - conducted power.

DUT Channels	Conducted power [dBm]	Max Radiated Power [dBm]	Antenna gain [dBi]
@ 2402 MHz	**7.03**	**5.82** θ=171deg,ϕ=90deg	-1.21
@ 2440 MHz	**7.19**	**7.83** θ=54deg,ϕ=90deg	0.64
@ 2480 MHz	**7.10**	**7.51** θ=18deg,ϕ=90deg	0.41

Product radiation pattern(EIRP)



[imgfile: tmp/Yoko _gnuplot20220609-12699-4eles6-0.png]

Radiation pattern #1:

YOKO_RadPatt_PB1_#52_TX_H_2402MHz

Average power = **0.71 dBm**
Front average power = **2.67 dBm** (From 0 deg to 180 deg)

Min power = **-10.17 dBm** @ -99.00 deg
Max power = **5.82 dBm** @ 171.00 deg

Radiation pattern #2:

YOKO_RadPatt_PB1_#52_TX_H_2440MHz

Average power = **2.95 dBm**
Front average power = **4.81 dBm** (From 0 deg to 180 deg)

Min power = **-8.08 dBm** @ -99.00 deg
Max power = **7.83 dBm** @ 54.00 deg

Delta max power = **2.01 dBm**
Delta average power = **2.24 dBm**
Delta front average power = **2.14 dBm**

Radiation pattern #3:

YOKO_RadPatt_PB1_#52_TX_H_2480MHz

Average power = **2.66 dBm**
Front average power = **4.46 dBm** (From 0 deg to 180 deg)

Min power = **-10.06 dBm** @ -123.00 deg
Max power = **7.51 dBm** @ 18.00 deg

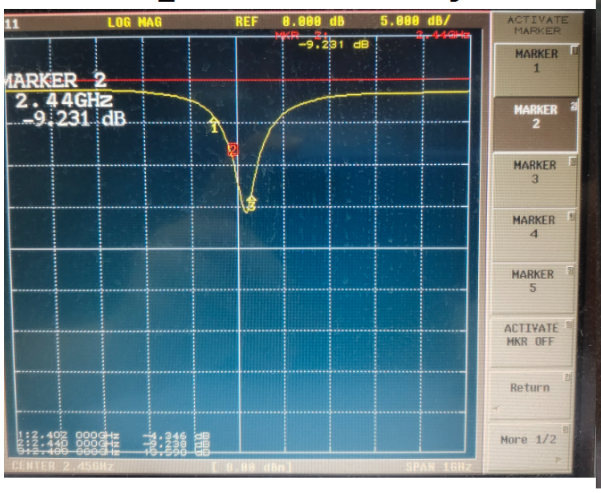
Delta max power = **1.69 dBm**
Delta average power = **1.95 dBm**
Delta front average power = **1.79 dBm**

3.3 S11 Measurement

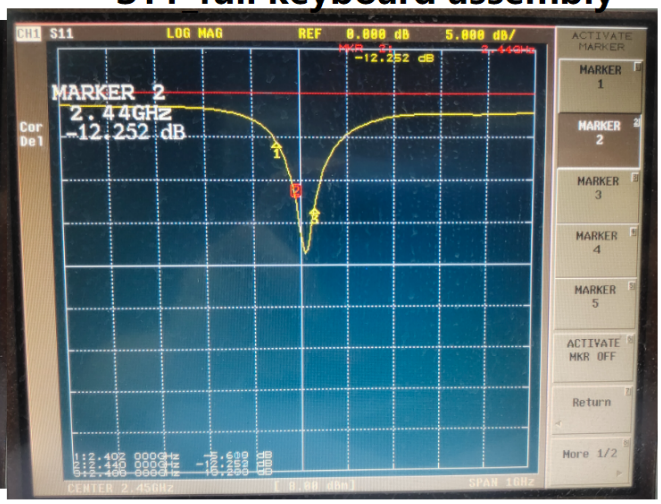
- S11 data

S11 [dB]	S11_main board only	S11_full keyboard assembly
@ 2402 MHz	-4.3	-5.6
@ 2440 MHz	-9.2	-12.2
@ 2480 MHz	-13.5	-13.2

S11_main board only



S11_full keyboard assembly



3.4 Summay

Brand	Walsin
Model No.	RFECA3216060A1T
Antenna type	LTCC chip Antenna
Operating band	2402~2480MHz
Antenna gain	0.64 dBi (max)
S11_full keyboard assembly	<-13.2dB
Antenna size	3.1mm x 1.6mm