Application Note：
Telink Mass Production Program And Test Plan

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Brief：

This document is the guide for Telink mass production procedure and total test plan.

TELINK SEMICONDUCTOR

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Revision History

Version	Major Changes	Date	Author
1.0.0	Initial release	2016/7	H.Z.F., L.X., Cynthia
1.1.0	Updated IR test description	2016/7	H.Z.F., Cynthia
1.2.0	Updated 2 Mass Production Procedure and 3.1 JIG test.	2017/9	L.X., Cynthia

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1 Brief Introduction

In this document, 8267 BLE Remote Control is taken as an example to present the instruction of mass production procedure and test plan, for those PCBA/module manufacturers based on Telink RF SoCs. Test items and related documents are introduced in details.

This document applies to mass production related engineers of customers and Telink.

1) Customers: Mass production related engineers

   ✧ Plan mass production procedure according to factory condition and project/customer requirements.

   ✧ Develop and make jig for each step during mass production procedure.

   ✧ Produce mass production software for each step during the procedure.

   ✧ Determine and debug test items and corresponding data standard for mass production.

   ✧ Develop/Obtain test software that can be used by workers directly.

   ✧ Verify test software.

   ✧ Determine and write standard operation procedure for workers, including each step of mass production.

2) Telink mass production support engineers

   ✧ Solve problems occurred during mass production.

   ✧ Analyze typical malfunctions.

   ✧ Increase yields (i.e. defect-free rate).

   ✧ Improve mass production efficiency.

2   Mass Production Procedure

Mass production procedure contains three phases: Pre-test (before firmware burning), Assembly, and Post-test (function test).

In Pre-test phase, user should use Telink test jig to test PCBA function before firmware burning.

In Assembly phase, user should assemble the PCBA burned with firmware, and ensure its good assembly via visual inspection, e.g. button press and release is normal, appearance is not damaged.

In Post-test phase, the PCBA has become finished product after assembly. User should use PC tool and some assistance device (e.g. Telink supplied Dongle, buzzer board), and follow product specification to test product functions, e.g. button, IR, audio function.

Mass production flowchart is shown as below:

Mass Production Procedure
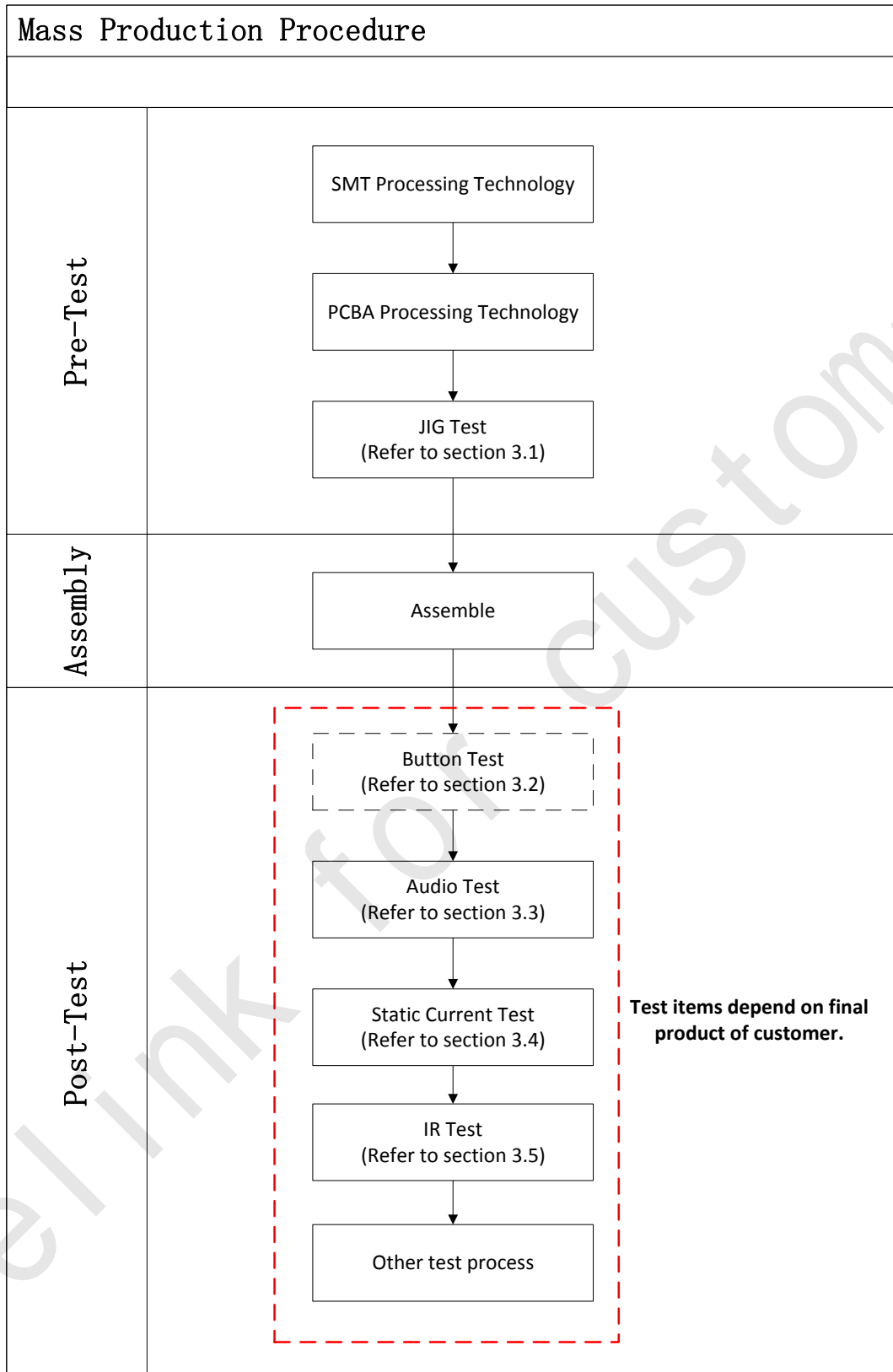
Figure 1   Mass production flowchart

3 Test Plan

3.1 JIG test

In Pre-test phase, Telink will provide the following materials to assist customer to finish JIG test.

1) In hardware, JIG Test System consists of core components and structure frame. Telink will supply the core components including JIG EVK, display board, antenna, and cables; while customer needs to follow his own production habit to make JIG frame, thimble board, and etc.

2) In software, Telink will provide corresponding control firmware (script) and PC tool, which serve to customize product test flow and collect test data.

3) Guide documents:

   a) User guide on hardware assembly and PC tool:

   AN_16052300_Assembly and Maintenance Manual for Telink BLE 1x6 Test System 3.1

   AN_16052601_Assembly and Maintenance Manual for Telink BLE 1x1 Test System 2.1

   b) User guide on script:

   AN_BLE-15090200 _Telink BLE Test Bench Script Manual

A BLE Remote Control (RC) with IR and audio based on TLSR8267F512ET32 is taken as an example to illustrate JIG auto test flow defined by control firmware (script), which represents the most comprehensive function test and takes 10.471s test time. For other application, test items can be tailored correspondingly.

```
┌─────────────────────┐
│      Initialize      │
│        3.1.1         │
└─────────────────────┘
           │
           ▼
┌─────────────────────┐
│ Short test (Optional)│
│        3.1.2         │
└─────────────────────┘
           │
           ▼
┌─────────────────────┐
│       RF test        │
│        3.1.3         │
└─────────────────────┘
           │
           ▼
┌─────────────────────┐
│      Flash test      │
│        3.1.4         │
└─────────────────────┘
           │
           ▼
┌─────────────────────┐
│ Power Management test│
│        3.1.5         │
└─────────────────────┘
           │
           ▼
┌─────────────────────┐
│    IR current test   │
│        3.1.6         │
└─────────────────────┘
           │
           ▼
┌─────────────────────┐
│   MIC function test  │
│        3.1.7         │
└─────────────────────┘
           │
           ▼
┌─────────────────────┐
│ 32kHz RC calibration test │
│        3.1.8         │
└─────────────────────┘
           │
           ▼
┌─────────────────────┐
│ Write compensation value │
│   into Flash (3.1.9) │
└─────────────────────┘
           │
           ▼
┌─────────────────────┐
│  Download and check  │
│  Firmware (3.1.10)   │
└─────────────────────┘
```
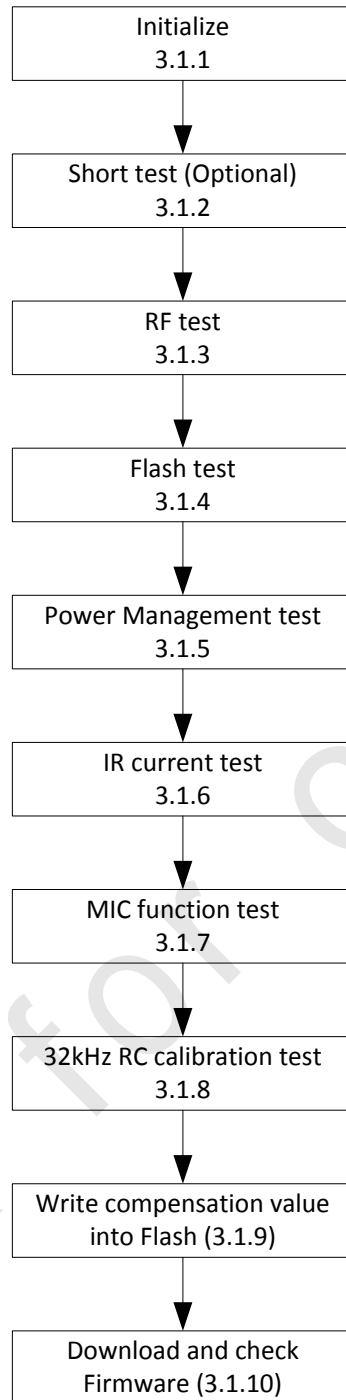
Figure 2   JIG test flowchart

3.1.1 Initialize

Table 1 Initialize

Test item	Initialize
Hardware platform	Telink JIG EVK, customer DUT
Test method	NA
Test purpose	Configure related parameters for JIG EVK and DUT.
Script command(s)	config(x) led_state(x)
Test time	24ms
Necessity	Necessary

3.1.2 Short test

Table 2 Short test

Test item	Short test
Hardware platform	Telink JIG EVK, customer DUT
Test method	Successively enable pull-up resistor for a GPIO to be tested and set it as input function, while other GPIOs should output low level. Judge if there is short circuit according to the level read by this GPIO to be tested: if it's high level, there's no short circuit; if it's low level, there's short circuit.
Test purpose	Check if there is short circuit between adjacent GPIOs.
Script command(s)	gpio_short(x)
Test time	326ms
Necessity	Optional: Customer should judge if this item is needed according to SMT processing yield.

3.1.3 RF test

Table 3 RF test

Test item	RF test
Hardware platform	Telink JIG EVK, customer DUT
Test method	1. Run specific bin file in DUT RAM to implement self-calibration. 2. Set JIG EVK and DUT as TX and RX mode, respectively. DUT should test power strength and number of packets transmitted by JIG EVK, so as to judge DUT Rx performance. 3. Set JIG EVK and DUT as RX and TX mode, respectively. JIG EVK should test power strength and number of packets transmitted by DUT, so as to judge DUT Tx performance.
Test purpose	Test DUT RF performance

Script command(s)	dutcmd(x)
	calib_frqoft(x)
	tx_cnt(x)
	tx_power(x)
	current_test(x)
	rx_cnt(x)
	rx_sensty(x)
Test time	3532ms
Necessity	Necessary

3.1.4 Flash test

Table 4 Flash test

Test item	Flash test
Hardware platform	Telink JIG EVK, customer DUT
Test method	JIG EVK directly erases specific Flash area of DUT via SWM.
Test purpose	Remove Flash write protection, erase firmware in DUT Flash to enable multiple test and burning.
Script command(s)	protect_flash(x) erase_flash(x)
Test time	3580ms (erase 64kB Flash)
Necessity	If multiple test and burning are needed by customer, this is a necessary item; otherwise it can be deleted.

3.1.5 Power management test

Table 5 PM test

Test item	Power management test
Hardware platform	Telink JIG EVK, customer DUT
Test method	JIG EVK enables DUT to enter sleep mode (suspend/deep sleep). Test current consumption in sleep status, and then wake up DUT via GPIO or Timer.
Test purpose	Test if sleep wakeup function is normal.
Script command(s)	dutcmd(x)
Test time	928ms
Necessity	Necessary

3.1.6 IR current test

Table 6 IR current test

Test item	IR current test
Hardware platform	Telink JIG EVK, customer DUT
Test method	JIG EVK enables DUT IR pin to output PWM waveforms, and test DUT current.
Test purpose	Test if DUT IR tube is assembled correctly.
Script command(s)	dutcmd(x)
Test time	1365ms
Necessity	IF DUT does not support IR function, this item can be deleted.

3.1.7 MIC function test

Table 7 MIC function test

Test item	MIC (microphone) function test
Hardware platform	Telink JIG EVK, customer DUT, buzzer board
Test method	JIG EVK controls buzzer board to generate voice with specific frequency. DUT starts recording. Obtain strength of corresponding signal via fast FFT.
Test purpose	Test if DUT MIC function is normal.
Script command(s)	dutcmd(x)
Test time	712ms
Necessity	IF DUT does not support MIC function, this item can be deleted.

3.1.8 32kHz RC calibration test

Table 8 32kHz RC calibration test

Test item	32kHz RC calibration test
Hardware platform	Telink JIG EVK, customer DUT
Test method	Run specific bin file in DUT RAM to implement internal 32kHz RC self-calibration.
Test purpose	Implement self-calibration for internal 32kHz RC.
Script command(s)	calib_32krc(x)
Test time	902ms
Necessity	Necessary

3.1.9 Write compensation value

Table 9 Write compensation value

Test item	Write compensation value
Hardware platform	Telink JIG EVK, customer DUT
Test method	JIG EVK writes various compensation values obtained via calibration into specific DUT flash area.
Test purpose	Ensure DUT can reach optimal performance.
Script command(s)	dutcmd(x)
Test time	61ms
Necessity	Necessary

3.1.10 Download and check firmware

Table 10   Download and check firmware

Test item	Download and check firmware
Hardware platform	Telink JIG EVK, customer DUT
Test method	JIG EVK downloads application firmware into DUT Flash and checks FW burning result.
Test purpose	Download application firmware correctly.
Script command(s)	write(x)
Test time	2948ms (firmware size is 27kB)
Necessity	Necessary

3.2 Button test

Table 11   Button test details

Item	Description		
DUT	Final product (after assembly)		
Hardware Requirement	RC is paired with Dongle successfully.		
RC firmware	8267_remote_bv200_tv1.0.bin		
Dongle firmware	8266_master_kma_dongle_can_tv_1.0.bin		
Software on PC	KeySimulator (factory version v1.7)		
Document	AN_16071802_Telink KeySimulator User Guide		
Test item requirements	Test item	Target	Parameter
	POWER	OK	DCH
	VOL+	OK	E9H

	VOL-	OK	EAH
	MUTE	OK	29H
	VOICE	OK	33H
	UP	OK	52H
	DOWN	OK	51H
	LEFT	OK	50H
	RIGHT	OK	4FH
	OK	OK	28H
	BACK	OK	0224H
	SETTINGS	OK	0125H
	HOME	OK	0223H
	MENU	OK	0139H
	INPUT	OK	34H
	CH+	OK	EBH
	CH-	OK	ECH
	PICTURE	OK	EDH
	AUDIO	OK	EFH
	CAN	OK	55H
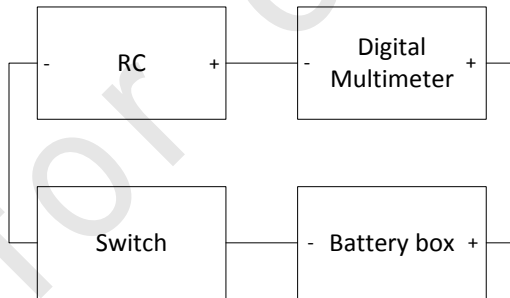
3.3 Audio test

Table 12   Audio test details

Item	Description
DUT	Final product (after assembly)
Hardware Requirement	RC, Dongle
RC firmware	8267_remote_bv200_tv1.0.bin
Dongle firmware	8266_master_kma_dongle_can_tv_1.0.bin
Software on PC	KeySimulator (factory version v1.7)
Document	AN_16071802_Telink KeySimulator User Guide
Test method	Pair RC with Dongle successfully. Signal generator acts as voice source and generates signal with specific frequency. RC starts recording, and reports test result to PC tool so as to show audio test success or failure.

3.4 Static current test

<p align="center">Table 13 Static current test details</p>

Test purpose	Test RC static current and verify if it meets the design requirement.
Test equipment	Digital multimeter, battery box (dual batteries), switch, wires.
Test preparation	After Dongle recognizes that all test items above succeed, Dongle will write a command via user-defined Bluetooth uuid, and control the RC to enter deep sleep. Then user can measure RC current in deep sleep mode via multimeter in series connection.
Test method	1. Set the digital multimeter as uA current gear. 2. Connect the multimeter in the RC circuit via series connection: 　　1) Connect positive and negative probe of the multimeter with anode of the battery box and anode of RC, respectively; 　　2) Connect two sides of switch with cathode of RC and cathode of battery box, respectively.

3.5 IR test

<p align="center">Table 14   IR test details</p>

Item	Description		
DUT	Final product (after assembly)		
Hardware Requirement	IR analyzer		
RC firmware	8267_remote_bv200_tv1.0.bin		
IR analyzer	Customer needs to prepare IR analyzer by himself.		
Test item	Test item	Target	Parameter

requirements	POWER	OK	0xDC
	VOL+	OK	0x97
	VOL-	OK	0x96
	MUTE	OK	0x9C
	VOICE	OK	N/A
	UP	OK	0xCA
	DOWN	OK	0xD2
	LEFT	OK	0x99
	RIGHT	OK	0xC1
	OK	OK	0xCE
	BACK	OK	0xC5
	SETTINGS	OK	0x8D
	HOME	OK	0x88
	MENU	OK	0x89
	INPUT	OK	0x08
	CH+	OK	0x85
	CH-	OK	0x86
	PICTURE	OK	0x49
	AUDIO	OK	0x48
	CAN	OK	0x55