4:1 Micro USB Switches with Accessory Detection

General Description

The RT8979 is a USB port accessory detector and switch (USB1, USB2, UART & MHL). The RT8979 adopts I^{2}C bus for control and also uses an internal method to determine the connected device.

The RT8979 provides a device detection function by using the USB ID signal pin and the VBUS voltage. The ID pin resistance and VBUS voltage determine the unique detection method for various accessory. The host microprocessor adopts I^{2}C to control the switch position and read the results of the accessory detection. The RT8979 also detects USB chargers including dedicated chargers (D+/D- shorted) and high power host/hub chargers.

Ordering Information

RT8979 □

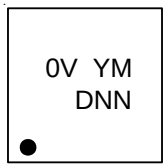
Package Type
WSC : WL-CSP-25B 2.07x2.07 (BSC)

Note :

Richtek products are :

- RoHS compliant and compatible with the current requirements of IPC/JEDEC J-STD-020.
- Suitable for use in SnPb or Pb-free soldering processes.

Marking Information



0V : Product Code

YMDNN : Date Code

Features

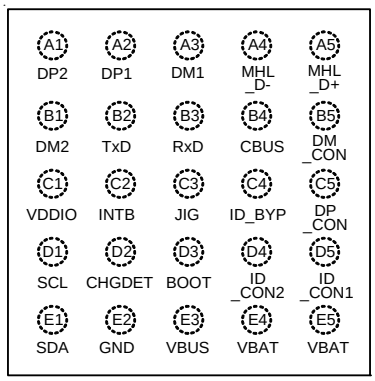
- **Hi-Speed USB Operation (USB1 & USB2)**
- **UART & MHL Switch**
- **Interrupt for Device Insertion and Removal**
- **Factory Support**
- **28V Maximum Rating for DC Adapter**
- **I^{2}C Controlled Interface**
- **DP_CON/DM_CON TVS Diode Integrated for Surge Protection Up to ±15V**
- **ID_CON TVS Diode Integrated for Surge Protection Up to ±20V**
- **Battery Charger Detection 1.2**

Applications

- Mobile Applications
- Smart Handheld device
- Tablets

Pin Configuration

(TOP VIEW)

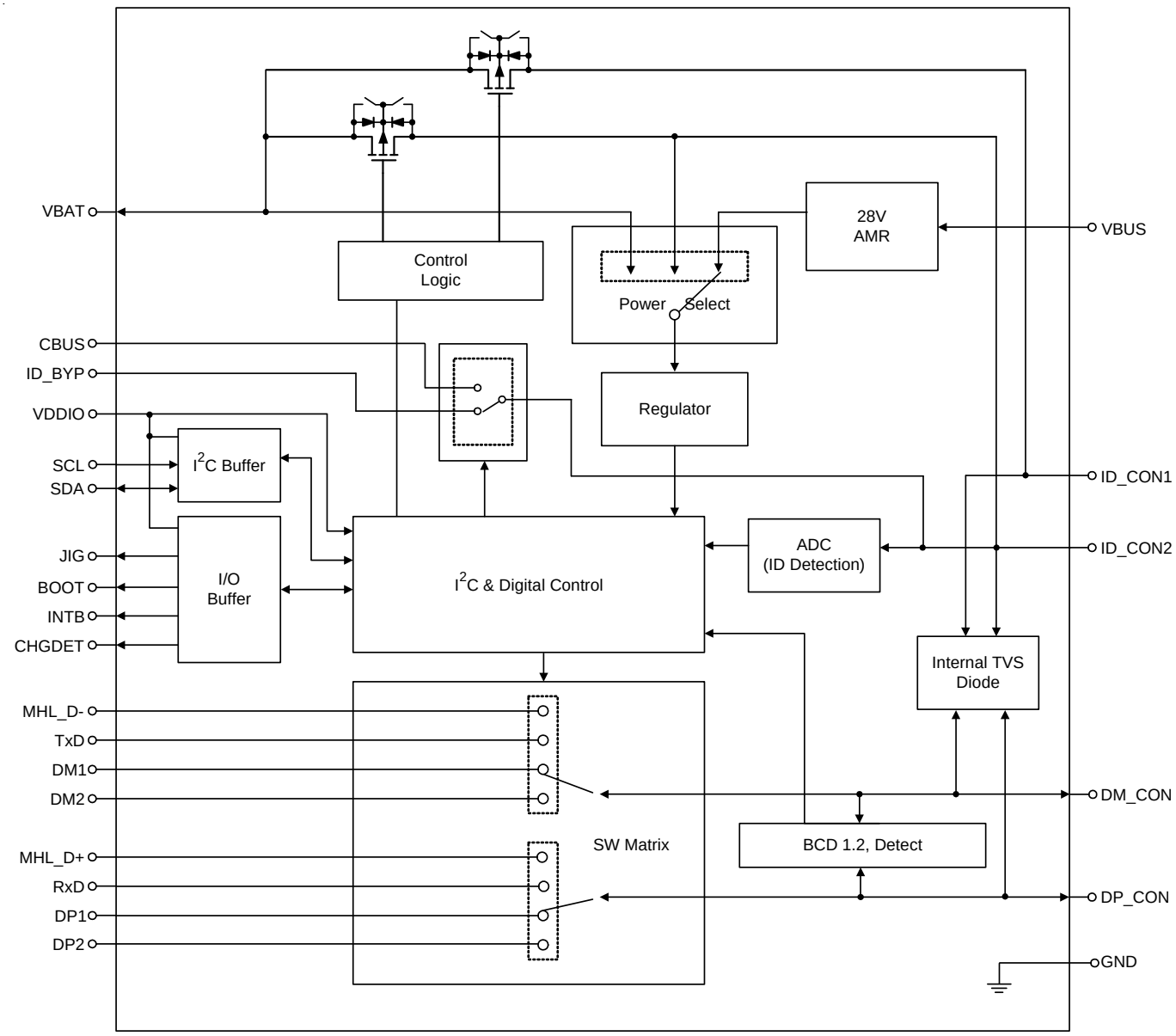


WL-CSP 25B 2.07x2.07 (BSC)

Functional Pin Description

Pin No.	Pin Name	Pin Function
A1	DP2	D+ signal switch path; dedicated USB port to be connected to USB_HOST2 on the cellphone.
A2	DP1	D+ signal switch path; dedicated USB port to be connected to USB_HOST1 on the cellphone.
A3	DM1	D- signal switch path; dedicated USB port to be connected to USB_HOST1 on the cellphone.
A4	MHL_D-	D- signal switch path; dedicated MHL port to be connected to MHL TX on the cellphone.
A5	MHL_D+	D+ signal switch path; dedicated MHL port to be connected to MHL TX on the cellphone.
B1	DM2	D- signal switch path; dedicated USB port to be connected to USB_HOST1 on the cellphone.
B2	TxD	Tx switch path from resident UART on the cellphone.
B3	RxD	Rx switch path from resident UART on the cellphone.
B4	CBUS	CBUS signal path; connected to the MHL TX on the cellphone.
B5	DM_CON	Connected to the USB connector D- pin. Depending on the signaling mode, this pin can be switched to DM1, DM2, MHL_D- or TxD.
C1	VDDIO	I^2C interface power; baseband processor interface I/O supply pin.
C2	INTB	Interrupt; active-low output used to prompt the phone baseband processor to read the I^2C register bits. Indicates a change in the ID_CON pin status or accessorires attach status.
C3	JIG	Active-low output control signal driven by the device and used for factory test modes.
C4	ID_BYP	ID signal switch path used during USB On-The-Go operation to allow phone transceiver access to the state of the ID pin on the USB connector.
C5	DP_CON	Connected to the USB Connector D+ Pin. Depending on the signaling mode, this pin can be switched to DP1, DP2, MHL_D+ or RxD.
D1	SCL	I^2C interface clock.
D2	CHGDET	Open-drain, active-low output; used to signal the charger IC that a charger has been attached.
D3	BOOT	Open-drain, output control signal driven by MUS and used by the processor for Force Download Mode, active-low and need external pull-up.
D4	ID_CON2	Connected to USB connector ID pin or SBU and used for external battery testing.
D5	ID_CON1	Connected to USB connector ID pin or SBU and used for detecting accessories or button presses and external battery testing.
E1	SDA	I^2C interface data.
E2	GND	Common ground.
E3	VBUS	Connected to the connector of VBUS.
E4, E5	VBAT	Battery voltage, connected to the positive terminal of the battery pack; VBAT is a power path connection.

Functional Block Diagram



Operation

The RT8979 is a USB port accessory detector and switch of USB, UART & MHL. The RT8979 supports accessory detection function through the unique characteristics from VBUS voltage, ID resistance and USB data line status.

The RT8979 is programmable by I^{2}C interface and it can communicate with microprocessor.

Absolute Maximum Ratings (Note 1)

- VBUS to GND ---------- –0.3V to 28V
- Other Pins to GND ---------- –0.3V to 6V
- USB & ID_CON to CBUS Switch I/O Current ---------- Max 25mA
- UART Switch I/O Current ---------- Max 12mA
- Continuous Current from ID_CON to VBAT (ID_CON1 shorted to ID_CON2) ---------- Max 2.5A
- Power Dissipation, P_D @ T_A = 25°C
  WL-CSP 25B 2.07x2.07 (BSC) ---------- 2.8W
- Package Thermal Resistance (Note 2)
  WL-CSP 25B 2.07x2.07 (BSC), θ_{JA} ---------- 35.6°C/W
- Lead Temperature (Soldering, 10 sec.) ---------- 260°C
- Junction Temperature ---------- 150°C
- Storage Temperature Range ---------- –65°C to 150°C
- ESD Susceptibility (Note 3)
  HBM (Human Body Model) ---------- 2kV

Recommended Operating Conditions (Note 4)

- Battery Supply Voltage, VBAT ---------- 3.0V to 4.7V
- USB Supply Voltage, VBUS ---------- 4V to 20V
- Processor Supply Voltage, VDDIO ---------- 1.7V to 3.6V
- Junction Temperature Range ---------- –40°C to 125°C
- Ambient Temperature Range ---------- –40°C to 85°C

Electrical Characteristics

(T_A = 25°C, unless otherwise specified)

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
Output High Voltage (for push-pull CMOS output pins)	V_{OH_PP}	I_{SOURCE} = 2mA		0.7 x VDDIO	--	--	V
Output Low Voltage (for push-pull CMOS output pins)	V_{OL_PP}	I_{SINK} = 10mA		--	--	0.4	V
Output Low Voltage (for open-drain output pins)	V_{OL_OD}	I_{SINK} = 1mA		--	--	0.4	V
Logic High Input Voltage (SDA, SCL)	V_{IH}			1.4	--	--	V
Logic Low Input Voltage (SDA, SCL)	V_{IL}			--	--	0.4	V
Input pin Leakge Current (SDA, SCL)	I_{INLEAK}	Input Voltage 0.26 to 2.3V		–10	--	10	µA
Low-Level Output Voltage at 3mA Sink Current (Open-Drain)	V_{OL1}	V_{DDIO} > 2V	(Note 5)	0	--	0.4	V
		V_{DDIO} < 2V		--	--	0.2 x V_{DDIO}	
Battery Supply Standby Current (No Accessory Attached)	I_{CCSB}	VBAT = 3 to 4.5V, no Accessory static current		--	5	10	µA

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Battery Supply Standby Current (with Accessory Attached)	I_{CCSB_ATT}	VBAT = 3.8V, with Accessory's static current	--	35	50	μA
Power Off Leakage Current On Data Ports	I_{OFF_DATA}	VBAT = 0, VSW = 3.6V	--	--	18	μA
Off-Leakage Current	I_{NO_OFF}	I/O Pins = 0.3V, VBAT = 3.0 to 4.5V	–0.5	--	0.5	μA
Current Consumption During FM8 With Only VBAT_ID as Power Supply	I_{CC_FM8}	VBAT_ID = 3.3 to 4.4V	--	60	--	μA
ID_CON Short-Circuit Current	I_{DSHRT}	VBAT = 3.0 to 4.5V, Current Limit if ID_CON = 0V	--	5	--	mA
USB 1/2 Switch Path						
USB Analog Signal Range	V_{SW_USB}	VBUS = 5V	0	--	3.6	V
USB Switch On Resistance	R_{ON_USB}	VBAT = 3 to 4.5V, VD+/- = 0V, 0.4V with I_{ON} = 8mA	--	6	--	Ω
DP_CON, DM_CON On Capacitance	C_{ON_USB}	VBAT = 3.8V, D+/- = 400mVpp, freq = 240MHz	--	10	--	pF
OFF Capacitance	C_{OFF_USB}	VBAT = 3.8V, freq = 240MHz	--	5	--	pF
Differential –3dB Bandwidth	BW (Insertion loss)	VBAT = 3.0V to 4.5V, V_{IN} = 400m V_{pk-pk}, RL = 50Ω, CL = 0pf, (on USB data paths) (Note 5)	--	700	--	MHz
UART Switch Path						
UART Analog Signal Range	V_{SW_UART}		0	--	4.4	V
UART Switch On Resistance	R_{ON_UART}	VBAT = 3.0 to 4.5V, VD+/- = 0V, 4.4V with I_{ON} = 2mA	--	28	--	Ω
MHL Switch Path						
MHL Analog Signal Range	V_{SW_MHL}		1.375	--	3.465	V
MHL Switch On Resistance	R_{ON_MHL}	VBAT = 3 to 4.5V, V_{SW} = 1.375 to 3.465V with I_{ON} = 8mA	--	5	--	Ω
VBAT MOSFET Switch Path						
VBAT MOSFET On Resistance, ID_CON1 shorted to ID_CON2	R_{ON_FET}	VBAT = 3 to 4.5V, I_{ON} = 1A @ Room Temperature	--	50	--	mΩ
Resistance from ID_CON1 to ID_CON2 when VBAT MOSFET is OFF	R_{IDVBAT_OFF}	VBAT = 3 to 4.5V	6	--	--	MΩ

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
ID Bypass Switch Path						
ID Analog Signal Range	V_{SW_ID}		0	--	1.8	V
ID Bypass Switch On Resistance	R_{ON_IDBP}	VBAT = 3 to 4.5V, V_{SW} = 0V, 1.8V with I_{ON} = 10mA	--	23	--	Ω
CBUS Switch Path						
CBUS Analog Signal Range	V_{SW_CBUS}		0	--	4.4	V
CBUS Switch On Resistance	R_{ON_CBUS}	VBAT = 3 to 4.5V, V_{SW} = 0V, 4.4V with I_{ON} = 10mA	--	14	--	Ω
Switch AC Eletrical Charateristics						
Time after INT Mask clear to 0 until INTB goes Low when INT Mask is set to 1	t_{INT_MASK}		--	10	--	ms
Time from VBUS Valid to USB Switches Turn On for SDP	t_{SDPDET}		--	300	--	ms
Time from VBUS Valid to USB Switches Turn On for CDP Only	t_{CHGOUT}		--	330	--	ms
Time from USB Switched Closed to CHGDET output Low for USB charging port (CDP only)	tCHGDET		--	300	--	ms
Time from ID_CON not floating to INTB Low to Signal Accessory attached ID_CON Resistance-based only (VBUS is not valid, No VBUS)	tIDDET		--	220	--	ms
Timeout Value for Data Contact During DCD Flow	$t_{DCD\_TIMEOUT}$	300 to 1200ms, 300ms/step, with one step to disable	--	300 600 900 1200 Disable	--	ms
Time for DCD Check the Contact is Successful (DCD Deglitch)	t_{DCD}		--	20	--	ms
Time for Standard ID Detection to Complete after ID Detects Contact	t_{ID_FLOW}		--	200	--	ms
Time for Standard Charger Detection Flow to Complete	t_{CHRG_FLOW}		--	300	--	ms
Time from VBAT on ID_CON Valid to VBAT MOSFET Closed ot Time from VBAT on ID_CON Invalid to VBAT MOSFET Open	t_{VBAT_FET}		--	5	--	ms

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Time from VBUS Invalid to VBAT MOSFET Closed, Only Applied to Factory Mode Phone-Off Leakage Mode	t_{NOVBUS_FET}		--	50	--	ms
Time from ID_CON not floating to BOOT LOW to signal that this is force-downloading mode	t_{RID_BOOT}		--	200	--	ms
JIG BOX Timing						
Time from VBUS Valid to RID on ID_CON Attached	t_{VBUS_RID}		--	10	200	ms
Time from RID Attached to VBAT on ID_CON Applied	t_{RID_VBAT}		400	--	--	ms
Time from JIG High to VBUS Removed	t_{BAT_OFF}		10	--	--	ms
Time from VBAT on ID_CON Valid to VBUS Removed	t_{VBAT_NOVBUS}		100	200	--	ms
Time from VBUS Valid to VBAT on ID_CON Removed	t_{VBUS_NOVBAT}		600	700	--	ms
Time VBUS invalid to next VBUS applied, only applied to force download mode without VBAT (FM5)	t_{NOVBUS_VBUS}		80	--	--	ms
Trim from ID_CON not floating to VBUS applied in force download mode with battery (FM3)	t_{RID_VBUS}		250	--	--	ms
RID Resistance Switching Time for Factory Mode	t_{FM_RID}		30	--	70	ms
Step Voltage for Falling Edge of VBAT on ID_CON	V_{FSTEP_ID}		--	2.65	--	V
Step Voltage for Falling Edge of VBUS	V_{FSTEP_VBUS}		--	3.2	--	V
Rising Time of VBAT on ID_CON	t_{rVBAT_ID}	Voltage from 10% to 90%	10	--	50	ms
I^2C AC Electrical Characteristics						
SCL Clock Frequency	f_{SCL}		0	--	400	kHz
Hold Time (Repeated) START Condition	$t_{HD;STA}$		0.6	--	--	µs
Low Period of SCL Clock	t_{LOW}		1.3	--	--	µs
High Period of SCL Clock	t_{HIGH}		0.8	--	--	µs
Set-Up Time for Repeated START Condition	$t_{SU;STA}$		0.6	--	--	µs
Data Hold Time	$t_{HD;DAT}$		0	--	0.9	µs

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Data Set-Up Time	$t_{SU;DAT}$		150	--	--	ns
Rise Time of SDA and SCL Signals	t_r		20	--	300	ns
Fall Time of SDA and SCL Signals	t_f		20	--	300	ns
Set-Up Time for STOP Condition	$t_{SU;STO}$		0.6	--	--	μs
Bus-Free Time between Stop and Start Condition	t_{BUF}		1.3	--	--	μs
Pulse width of spikes that must be suppressed by input filter	t_{SP}	(Note 5)	0	--	100	ns

Note 1. Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions may affect device reliability.

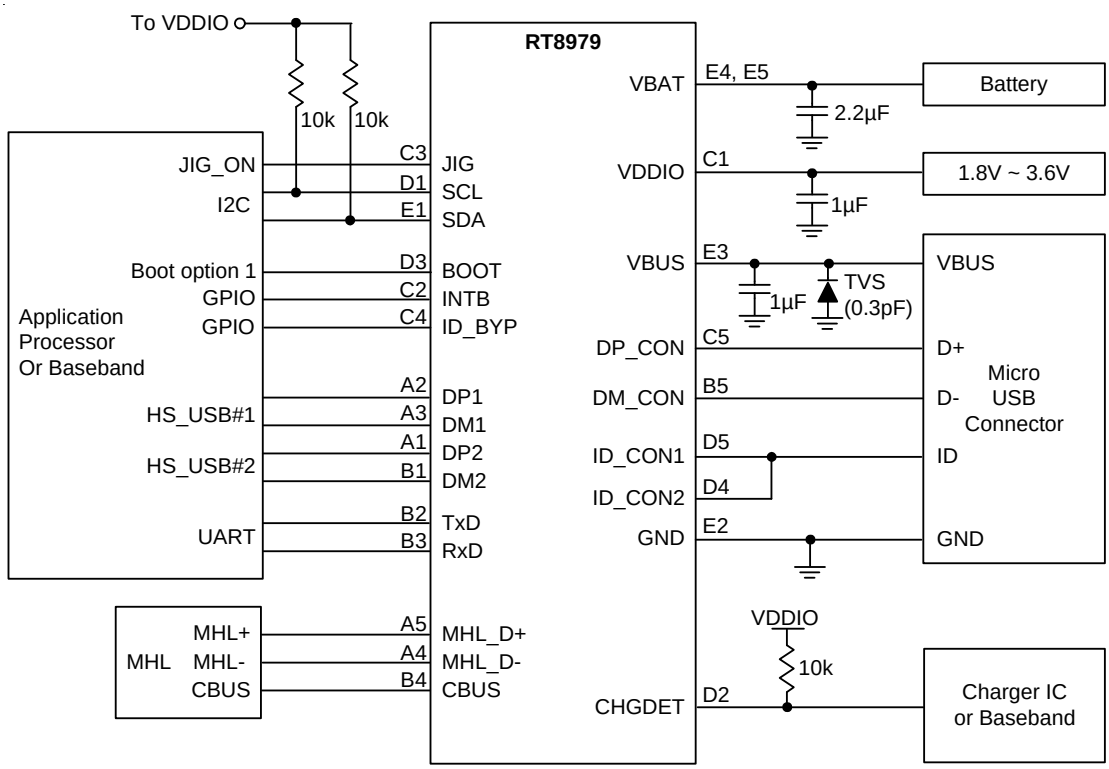
Note 2. θ_{JA} is measured under natural convection (still air) at T_A = 25°C with the component mounted on a high effective-thermal-conductivity four-layer test board on a JEDEC 51-7 thermal measurement standard.

Note 3. Devices are ESD sensitive. Handling precaution is recommended.

Note 4. The device is not guaranteed to function outside its operating conditions.

Note 5. These items are GBD.

Typical Application Circuit



Application Information

Power States Combinations

When power is first applied, the device is reset, all the registers are initialized to the default values shown in the register table.

All the combinations of V_{BUS}, V_{BAT}, power on ID_CON and V_{DDIO} are shown in Table 1.

V_{BAT} is used as the primary power supply for normal operation. V_{DDIO} is the dedicated IO voltage and is only used for I^2C interface and interrupt processing within the RT8979.

Table 1. Power States Combinations

V_{BUS}	V_{BAT}	Power on ID_CON	V_{DDIO}	Power State	Processor Communication (I^2C & Interrupts)	Detection VBUS & ID_CON
N	N	N	N	Power Down	NO	NO
N	N	N	Y		ILLEGAL STATE	
N	N	Y	N	Powered from ID_CON	NO	NO
N	N	Y	Y	Powered from ID_CON	YES	NO
N	Y	N	N	Powered from VBAT	NO	YES
N	Y	N	Y	Powered from VBAT	YES	YES
N	Y	Y	N		ILLEGAL STATE	
N	Y	Y	Y		ILLEGAL STATE	
Y	N	N	N	Powered from VBUS	NO	YES
Y	N	N	Y	Powered from VBUS	YES	YES
Y	N	Y	N	Powered from VBUS	NO	NO
Y	N	Y	Y	Powered from VBUS	YES	NO
Y	Y	N	N	Powered from VBAT	NO	YES
Y	Y	N	Y	Powered from VBAT	YES	YES
Y	Y	Y	N		ILLEGAL STATE	
Y	Y	Y	Y		ILLEGAL STATE	

Device Identification

The RT8979 supports multiple accessories by detecting unique characteristics including VBUS voltage, ID resistance and USB data line status. These characteristics are shown in Table 2 to Table 3.

Table 2. ADC Selection Table

ADC Value	ID_CON Resistance to GND (kΩ)			Accessory Detected	
	Min.	Typ.	Max.		
00000	0.00	0.00	0.01	USB OTG Mode	
00001	0.80	1.00	1.20	MHL Cable	
00010	1.94	2.00	2.06	Battery Charge Test (FM1)	Factory Test Mode
00011	2.53	2.60	2.68	Factory Mode Boot USB (FM2)	
00100	3.12	3.21	3.30	Force download with battery (FM3)	
00101	3.90	4.01	4.13	Factory Mode Boot UART (FM4)	
00110	4.68	4.82	4.96	For download without battery (FM5)	
00111	5.85	6.03	6.21	Battery Discharge Test (FM6)	
01000	7.79	8.03	8.27	RF Calibration (FM7)	
01001	9.73	10.03	10.33	Phone-off Current Drain Test (FM8)	
01010	11.67	12.03	12.39	MHL BIST (FM9)	
01011	14.03	14.46	14.89	RF calibration with Communication Processor (CP) (FM10)	
01100	16.75	17.26	17.77	Factory Mode Boot USB with CP (FM11)	
01101	19.89	20.50	21.11	Reserved Accessory 1	
01110	23.35	24.07	24.79	Reserved Accessory 2	
01111	27.27	28.70	30.13	Reserved Accessory 3	
10000	32.98	34.0	35.02	Reserved Accessory 4	
10001	39.00	40.20	41.40	Reserved Accessory 5	
10010	48.41	49.90	51.39	Reserved Accessory 6	
10011	62.96	64.90	66.84	Reserved Accessory 7	
10100	76.10	80.70	84.10	Customer Accessory 1	
10101	98.94	102.00	105.10	Customer Accessory 2	
10110	115.00	121.00	127.00	Customer Accessory 3	
10111	143.00	150.00	157.00	UART Cable	
11000	198.00	200.00	202.00	Customer Accessory 4	
11001	247.30	255.00	262.70	Reserved Accessory 10	
11010	291.90	301.00	310.10	Reserved Accessory 11	
11011	347.00	365.00	383.00	Customer Accessory 5	
11100	428.70	442.00	455.30	Customer Accessory 6	
11101	600.40	619.00	637.60	Reserved Accessory 12	
11110	750.00	1000.00	105.00	Customer Accessory 7	
11111	6000.00	Open		CDP, SDP, CDP	

Table 3. Automatic Accessory Configuration

Configuration Type	DP_CON	DM_CON	ID_CON	BOOT	JIG	CHG_DET
UART	RxD	TxD	OPEN	HI-Z	LOW	HI-Z
USB	DP1	DM1	ID BYP	HI-Z	LOW	HI-Z
SDP	DP1	DM1	ID BYP	HI-Z	LOW	LOW
CDP	DP1	DM1	ID BYP	HI-Z	LOW	HI-Z
MHL	MHL_D+	MHL_D-	CBUS	HI-Z	LOW	HI-Z
DCP	DP1	DM1	OPEN	HI-Z	LOW	LOW
Customer Accessory	OPEN	OPEN	OPEN	HI-Z	LOW	HI-Z
Reserved Accessory	OPEN	OPEN	OPEN	HI-Z	LOW	HI-Z

Factory-Mode Accessories

The RT8979 supports up to eleven different Factory Modes (FM). These modes are entered by detecting different R_{ID} resistor values. The ID_CON pin is also used to provide power in several modes by closing the VBAT MOSFET.

- FM1 - Battery Charge Test → Tests charger & battery
- FM2 - USB Test Boot → Tests the USB using AP
- FM3 - Force-Download Mode with Battery → Enter AP force download mode with internal battery
- FM4 - UART Test Boot ON → Tests the UART path
- FM5 - Force-Download Mode without Battery → Enter AP force download mode without internal battery
- FM6 - Battery Discharge Test → Tests the phone battery discharge
- FM7 - RF Calibration → Tests the RF section of the phone using AP
- FM8 - Phone-Off Current Drain Test → Tests the current drain when the phone is off
- FM9 - MHL BIST→ Mobile High Definition Link Built-In Self-Test
- FM10 - RF Calibration with CP → Tests the RF section of the phone using Baseband
- FM11 - USB Test Boot with CP → Tests the USB path using Baseband

Table 4. FM1 - Battery Charge Test

Sequence	JIGBOX				RT8979						
	ID_JIG	VBUS_JIG	DM_JIG	DM_JIG	VBUS	ID_CON	DP_CON	DM_CON	JIG	BOOT	CHGDET
1	Floating	5V	Open	Open	VBUS_JIG	Detection	Open	Open	LOW	Hi-Z	Hi-Z
2	2kΩ	5V	Open	Open	VBUS_JIG	OPEN	DP1	DM1	LOW	Hi-Z	Hi-Z
3	VBAT	5V	Open	Open	VBUS_JIG	VBAT	DP1	DM1	LOW	Hi-Z	Hi-Z
4	Monitor Current				VBUS_JIG	VBAT	DP1	DM1	LOW	Hi-Z	Hi-Z
5	2kΩ	5V	Open	Open	VBUS_JIG	Detection	Open	Open	LOW	Hi-Z	Hi-Z

Table 5. FM2 - USB Test Boot

Sequence	JIGBOX				RT8979						
	ID_JIG	VBUS_JIG	DM_JIG	DM_JIG	VBUS	ID_CON	DP_CON	DM_CON	JIG	BOOT	CHGDET
1	Floating	5V	Open	Open	VBUS_JIG	Detection	Open	Open	LOW	Hi-Z	Hi-Z
2	2.604kΩ	5V	DP1	DM1	VBUS_JIG	OPEN	DP1	DM1	LOW	Hi-Z	Hi-Z
3	VBAT	5V	DP1	DM1	VBUS_JIG	VBAT	DP1	DM1	LOW	Hi-Z	Hi-Z
4	Monitor Current		Test USB		VBUS_JIG	VBAT	DP1	DM1	LOW	Hi-Z	Hi-Z
5	2.604kΩ	5V	Open	Open	VBUS_JIG	Detection	Open	Open	LOW	Hi-Z	Hi-Z

Table 6. FM4 - UART Test Boot ON

Sequence	JIGBOX				RT8979						
	ID_JIG	VBUS_JIG	DM_JIG	DM_JIG	VBUS	ID_CON	DP_CON	DM_CON	JIG	BOOT	CHGDET
1	Floating	5V	Open	Open	VBUS_JIG	Detection	Open	Open	LOW	Hi-Z	Hi-Z
2	4.014kΩ	5V	DP1	DM1	VBUS_JIG	OPEN	RxD	TxD	LOW	Hi-Z	Hi-Z
3	VBAT	5V	DP1	DM1	VBUS_JIG	VBAT	RxD	TxD	LOW	Hi-Z	Hi-Z
4	Monitor Current		Test USB		VBUS_JIG	VBAT	RxD	TxD	LOW	Hi-Z	Hi-Z
5	4.014kΩ	5V	Open	Open	VBUS_JIG	Detection	Open	Open	LOW	Hi-Z	Hi-Z

Table 7. FM11 - USB Test Boot with CP

Sequence	JIGBOX				RT8979						
	ID_JIG	VBUS_JIG	DM_JIG	DM_JIG	VBUS	ID_CON	DP_CON	DM_CON	JIG	BOOT	CHGDET
1	Floating	5V	Open	Open	VBUS_JIG	Detection	Open	Open	LOW	Hi-Z	Hi-Z
2	17.26kΩ	5V	DP2	DM2	VBUS_JIG	OPEN	DP2	DM2	LOW	Hi-Z	Hi-Z
3	VBAT	5V	DP2	DM2	VBUS_JIG	VBAT	DP2	DM2	LOW	Hi-Z	Hi-Z
4	Monitor Current		Test USB		VBUS_JIG	VBAT	DP2	DM2	LOW	Hi-Z	Hi-Z
5	17.26kΩ	5V	Open	Open	VBUS_JIG	Detection	Open	Open	LOW	Hi-Z	Hi-Z

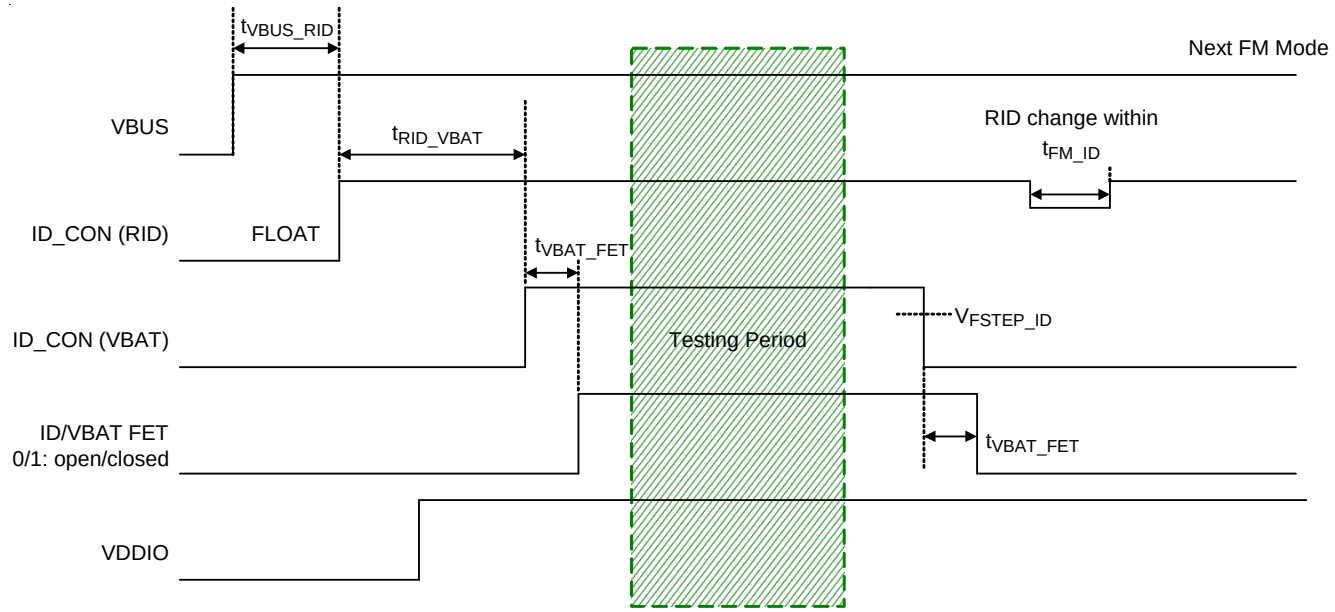


Figure 1. Timing for FM1/2/4/11

Table 8. FM3 - Force-Download Mode with Battery

Sequence	JIGBOX				RT8979						
	ID_JIG	VBUS_JIG	DM_JIG	DM_JIG	VBUS	ID_CON	DP_CON	DM_CON	JIG	BOOT	CHGDET
1	Floating	0V	Open	Open	VBUS_JIG	Detection	Open	Open	LOW	Hi-Z	Hi-Z
2	3.208kΩ	0V	DP1	DM1	VBUS_JIG	OPEN	DP1	DM1	LOW	LOW	Hi-Z
3	3.208kΩ	5V	DP1	DM1	VBUS_JIG	VBAT	DP1	DM1	LOW	LOW	Hi-Z
4	Force Downloading				VBUS_JIG	VBAT	DP1	DM1	LOW	LOW	Hi-Z
5	3.208kΩ	5V	Open	Open	VBUS_JIG	Detection	Open	Open	LOW	Hi-Z	Hi-Z

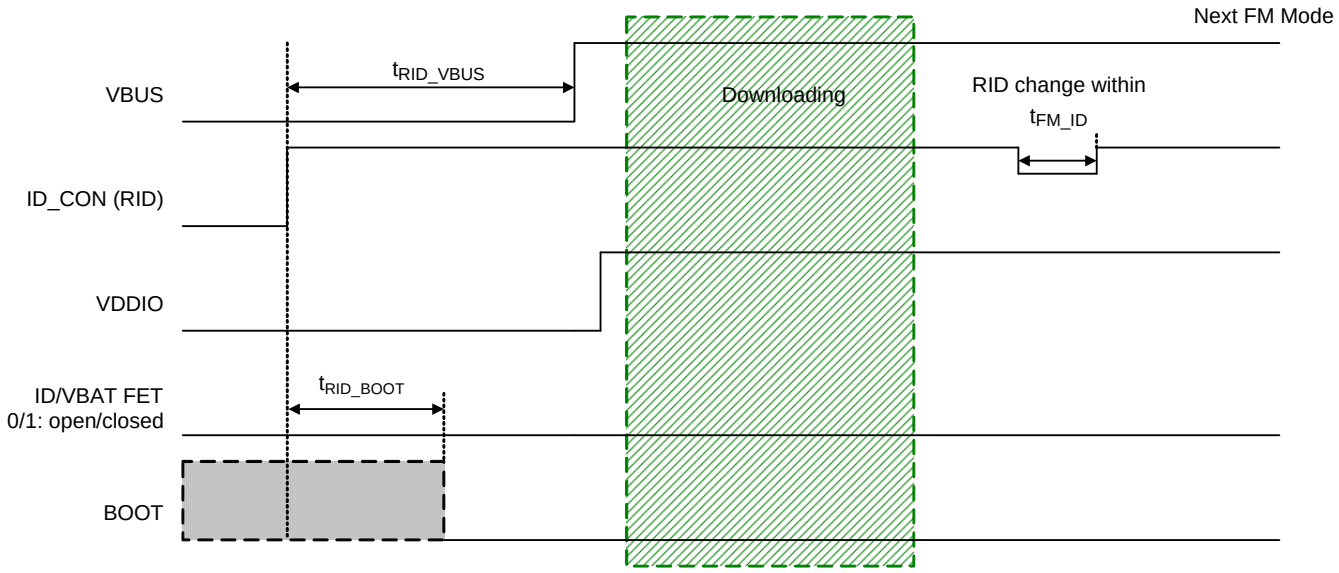


Figure 2. Timing for FM3

Table 9. FM5 - Force-Download Mode without Battery

Sequence	JIGBOX				RT8979						
	ID_JIG	VBUS_JIG	DM_JIG	DM_JIG	VBUS	ID_CON	DP_CON	DM_CON	JIG	BOOT	CHGDET
1	Floating	5V	Open	Open	VBUS_JIG	Detection	Open	Open	LOW	Hi-Z	Hi-Z
2	4.82kΩ	5V	DP1	DM1	VBUS_JIG	OPEN	DP1	DM1	LOW	LOW	Hi-Z
3	VBAT	0V	DP1	DM1	VBUS_JIG	VBAT	DP1	DM1	LOW	LOW	Hi-Z
4	Force Downloading				VBUS_JIG	VBAT	DP1	DM1	LOW	LOW	Hi-Z
5	4.82kΩ	5V	Open	Open	VBUS_JIG	Detection	Open	Open	LOW	Hi-Z	Hi-Z

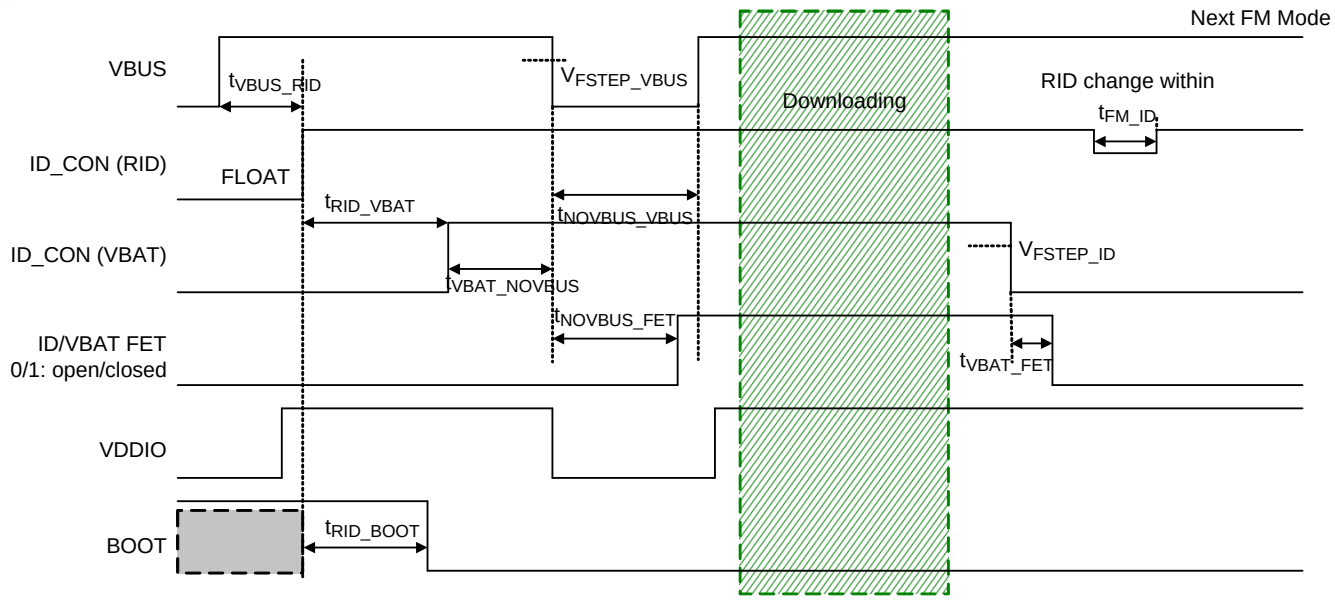


Figure 3. Timing for FM5

Table 20. FM6 - Battery Discharge Test

Sequence	JIGBOX				RT8979						
	ID_JIG	VBUS_JIG	DM_JIG	DM_JIG	VBUS	ID_CON	DP_CON	DM_CON	JIG	BOOT	CHGDET
1	Floating	5V	Open	Open	VBUS_JIG	Detection	Open	Open	LOW	Hi-Z	Hi-Z
2	6.03kΩ	5V	Open	Open	VBUS_JIG	OPEN	Open	Open	HIGH	Hi-Z	Hi-Z
3	VBAT	0V	Open	Open	VBUS_JIG	VBAT	Open	Open	HIGH	Hi-Z	Hi-Z
4	Monitor Current				VBUS_JIG	VBAT	Open	Open	HIGH	Hi-Z	Hi-Z
5	6.03kΩ	5V	Open	Open	VBUS_JIG	Detection	Open	Open	LOW	Hi-Z	Hi-Z

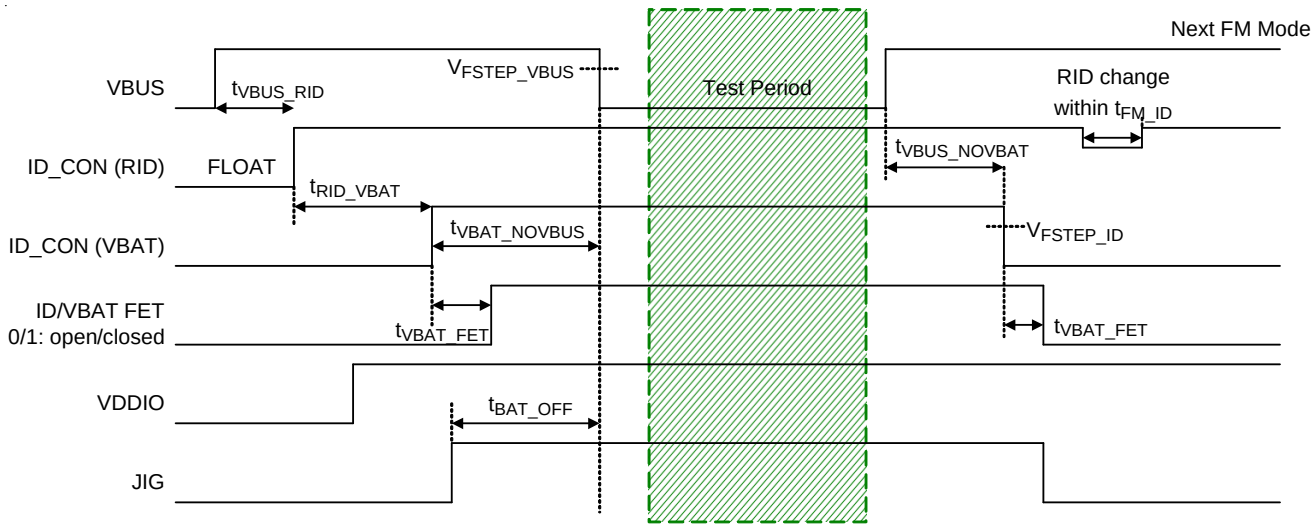


Figure 4. Timing for FM6

Table 21. FM7 - RF Calibration

Sequence	JIGBOX				RT8979						
	ID_JIG	VBUS_JIG	DM_JIG	DM_JIG	VBUS	ID_CON	DP_CON	DM_CON	JIG	BOOT	CHGDET
1	Floating	5V	Open	Open	VBUS_JIG	Detection	Open	Open	LOW	Hi-Z	Hi-Z
2	8.03kΩ	5V	DP1	DM1	VBUS_JIG	OPEN	DP1	DM1	LOW	Hi-Z	Hi-Z
3	JIG_VBAT	0V	DP1	DM1	VBUS_JIG	JIG_VBAT	DP1	DM1	LOW	Hi-Z	Hi-Z
4	RF Calibration				VBUS_JIG	JIG_VBAT	DP1	DM1	LOW	Hi-Z	Hi-Z
5	8.03kΩ	5V	Open	Open	VBUS_JIG	Detection	Open	Open	LOW	Hi-Z	Hi-Z

Table 22. FM10 - RF Calibration with CP

Sequence	JIGBOX				RT8979						
	ID_JIG	VBUS_JIG	DM_JIG	DM_JIG	VBUS	ID_CON	DP_CON	DM_CON	JIG	BOOT	CHGDET
1	Floating	5V	Open	Open	VBUS_JIG	Detection	Open	Open	LOW	Hi-Z	Hi-Z
2	14.46kW	5V	DP2	DM2	VBUS_JIG	OPEN	DP2	DM2	LOW	Hi-Z	Hi-Z
3	JIG_VBAT	0V	DP2	DM2	VBUS_JIG	JIG_VBAT	DP2	DM2	LOW	Hi-Z	Hi-Z
4	RF Calibration				VBUS_JIG	JIG_VBAT	DP2	DM2	LOW	Hi-Z	Hi-Z
5	14.46kΩ	5V	Open	Open	VBUS_JIG	Detection	Open	Open	LOW	Hi-Z	Hi-Z

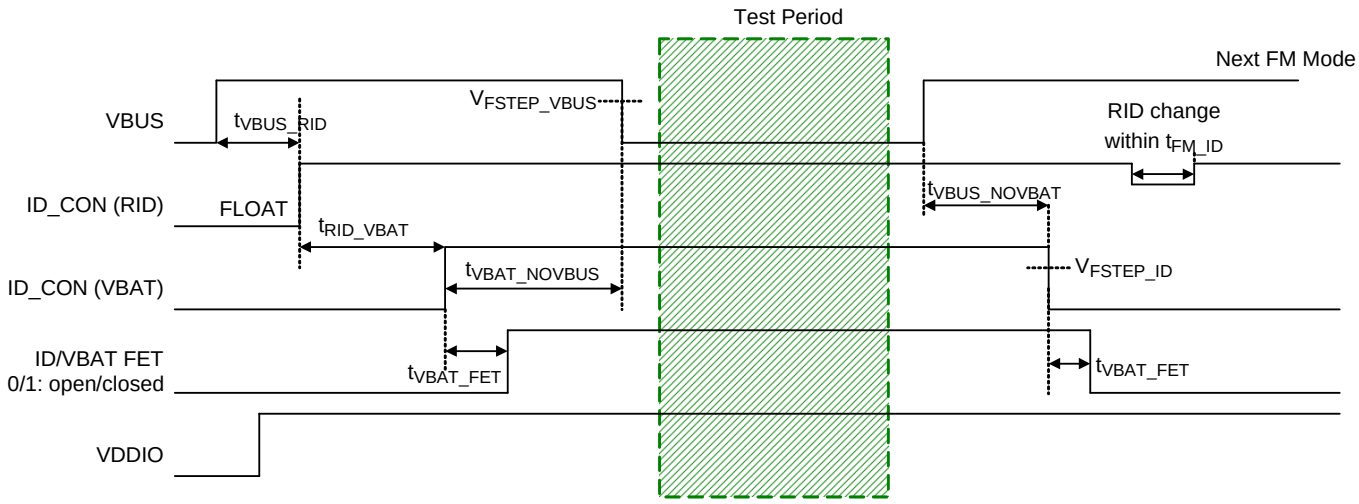


Figure 5. Timing for FM7/10

Table 23. FM8 - Phone-Off Current Drain Test

Sequence	JIGBOX				RT8979						
	ID_JIG	VBUS_JIG	DM_JIG	DM_JIG	VBUS	ID_CON	DP_CON	DM_CON	JIG	BOOT	CHGDET
1	Floating	5V	Open	Open	VBUS_JIG	Detection	Open	Open	LOW	Hi-Z	Hi-Z
2	10.03kΩ	5V	Open	Open	VBUS_JIG	OPEN	Open	Open	HIGH	Hi-Z	Hi-Z
3	VBAT	0V	Open	Open	VBUS_JIG	VBAT	Open	Open	HIGH	Hi-Z	Hi-Z
4	Monitor Current				VBUS_JIG	VBAT	Open	Open	HIGH	Hi-Z	Hi-Z
5	10.03kΩ	5V	Open	Open	VBUS_JIG	Detection	Open	Open	LOW	Hi-Z	Hi-Z

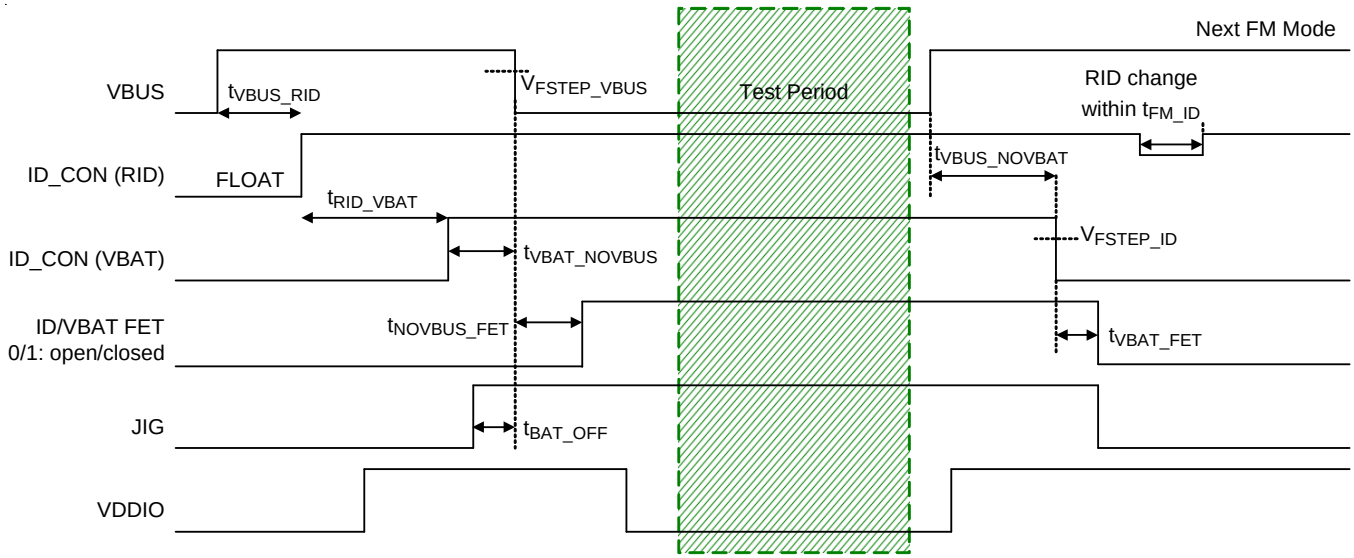


Figure 6. Timing for FM8

Table 24. FM9 - MHL BIST

Sequence	JIGBOX				RT8979						
	ID_JIG	VBUS_JIG	DM_JIG	DM_JIG	VBUS	ID_CON	DP_CON	DM_CON	JIG	BOOT	CHGDET
1	Floating	5V	Open	Open	VBUS_JIG	Detection	Open	Open	LOW	Hi-Z	Hi-Z
2	12.03kΩ	5V	MHL_D+	MHL_D-	VBUS_JIG	Detection	MHL_D+	MHL_D-	LOW	Hi-Z	Hi-Z
3	12.03kΩ	5V	MHL_D+	MHL_D-	VBUS_JIG	Detection	MHL_D+	MHL_D-	LOW	Hi-Z	Hi-Z
4	Monitor Current				VBUS_JIG	Detection	MHL_D+	MHL_D-	LOW	Hi-Z	Hi-Z
5	12.03kΩ	5V	Open	Open	VBUS_JIG	Detection	Open	Open	LOW	Hi-Z	Hi-Z

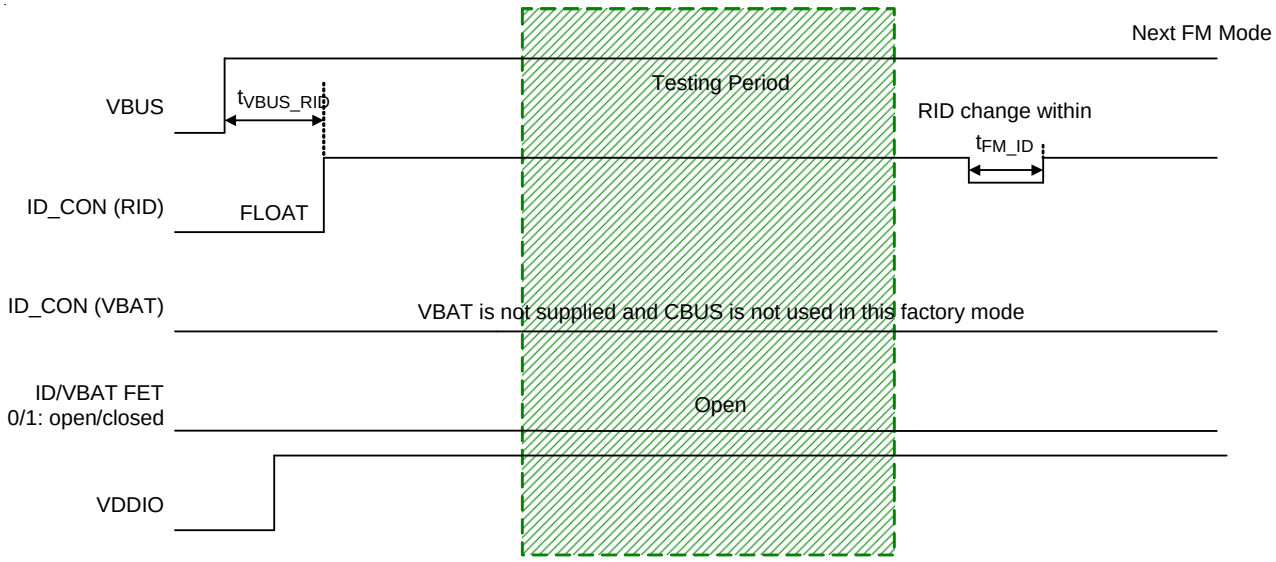


Figure 7. Timing for FM9

Register Table

(Slave address = 0100101x = 0x25)

Name	Address	Description
Device ID	0x01	Device ID
MUIC Control 1	0x02	MUIC control 1
Interrupt	0x03	MUIC Interrupt
Interrupt mask	0x04	MUIC Interrupt mask
ADC	0x05	ADC value (real ADC)
Timing Set 1	0x06	MUIC Timing setting 1
Detach Control	0x07	Detach status
Device Type 1	0x08	Device type list 1 of ID & BCD detection
Device Type 2	0x09	Device type list 2 of ID & BCD detection
Device Type 3	0x0A	Device type list 3 of ID & BCD detection
Manual S/W 1	0x0B	Manually switching control 1
Manual S/W 2	0x0C	Manually switching control 2
Timing Set 2	0x0D	MUIC Timing setting 2
MUIC Control 2	0x0E	DCD timeout control
Device Type 4	0x0F	Device Type 4
MUIC Control 3	0x10	MUIC control 3
MUIC Control 4	0x11	MUIC control 4
MUIC Status 1	0x12	MUIC status 1
MUIC Status 2	0x13	MUIC status 2
Stable ADC	0x18	ADC Value (stable ADC)
Reset	0x19	Reset

Address	Name	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0x01	Device ID	REVISION_ID					VENDOR_ID		
	Reset Value	0	0	0	1	0	0	0	1
	Read/Write	R	R	R	R	R	R	R	R
REVISION_ID		00010 for 2nd revision							
VENDOR_ID		001 : RichTek							
0x02	MUIC Control1	Reserved	Reserved	Reserved	SW OPEN	RAW Data	Manual SW	Wait	INT_MASK
	Reset Value	0	0	0	1	1	1	1	1
	Read/Write	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
SW OPEN		0 : Open all switches 1 : Automatic switching by accessory status							
RAW Data		0 : Report the status changes on ID_CON pin to processor 1 : Don't report the status changes on ID_CON pin to processor							
Manual SW		0 : Manual switching 1 : Auto-configuration							
Wait		0 : Keep all switches open until this bit is reset to 1 by the phone; when reset to 1, immediately configure the switches 1 : Wait "Switching Wait Time (specified in Timing Set 1 register)" before configuring switches, depending on the manual switching "Manual SW" bit							
INT_MASK		0 : Unmask interrupt (interrupt baseband processor on change of state in either INT registers) 1 : Mask interrupt (do not interrupt baseband processor)							

Address	Name	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0x03	INT1	ADC_CHG	Reserved_ Attach	VBUS_ Change	Device Change	Reserved	Reserved	Detach	Attach
	Reset Value	0	0	0	0	0	0	0	0
	Read/Write	R/C	R/C	R/C	R/C	R/C	R/C	R/C	R/C
ADC_CHG		1 : ADC register value changed; only enabled when RAW Data Mode is enable 0 : ADC value has not changed							
Reserved_Attach		1 : Reserved accessory is attached 0 : Reserved accessory is not attached							
VBUS_Change		1 : VBUS change has occurred 0 : VBUS change hasn't occurred							
Device Change		1 : Device change has occurred 0 : Device change hasn't occurred							
Detach		1 : Accessory detached 0 : Accessory not detached							
Attach		1 : Accessory attached 0 : Accessory not attached							
0x04	INT MASK1	ADC_CHG	Reserved_ Attach	VBUS_ Change	Device Change	Reserved	Reserved	Detach	Attach
	Reset Value	0	0	1	0	0	0	0	0
	Read/Write	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
ADC_CHG		1 : Mask ADC value change interrupt 0 : Do no mask ADC value change interrupt							
Reserved_Attach		1 : Mask reserved accessory attach interrupt 0 : Do no mask reserved accessory attach interrupt							
VBUS_Change		1 : Mask VBUS change interrupt 0 : Do no mask VBUS change interrupt							
Device Change		1 : Mask Device change interrupt 0 : Do no mask Device change interrupt							
Detach		1 : Mask detach interrupt 0 : Do no mask detach interrupt							
Attach		1 : Mask attach interrupt 0 : Do no mask attach interrupt							
0x05	ADC	Reserved	Reserved	Reserved	ADC Value				
	Reset Value	0	0	0	0	0	0	0	0
	Read/Write	R	R	R	R	R	R	R	R
ADC Value		ADC value by ID detection results (real time)							

Address	Name	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0x06	Timing Set 1	Switching Wait				ADC Detection Time			
	Reset Value	0	0	0	0	0	0	0	0
	Read/Write	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Switching Wait		0000 : 10ms 0001 : 30ms 0010 : 50ms 0011 : 70ms 0100 : 90ms 0101 : 110ms 0110 : 130ms 0111 : 150ms 1000 : 170ms 1001 : 190ms 1010 : 210ms 1011 : 230ms 1100 : 250ms 1101 : 270ms 1110 : 290ms 1111 : 310ms							
ADC Detection Time		ID stable time 0000 : 50ms 0001 : 100ms 0010 : 150ms 0011 : 200ms 0100 : 300ms 0101 : 400ms 0110 : 500ms 0111 : 600ms 1000 : 700ms 1001 : 800ms 1010 : 900ms 1011 : 1000ms 1100 : 1100ms 1101 : 1200ms 1110 : 1300ms 1111 : 1400ms							
0x07	Detach Control	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Accessory detach
	Reset Value	0	0	0	0	0	0	0	0
	Read/Write	R	R	R	R	R	R	R	R
Accessory detach		1 : Accessory has been detached 0 : Accessory hasn't been detached							

Address	Name	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0x08	Device Type 1	USB OTG	DCP	CDP	MHL	UART	SDP	JIG RF Calibration CP	JIG USB-ON CP
	Reset Value	0	0	0	0	0	0	0	0
	Read/Write	R	R	R	R	R	R	R	R
USB OTG		1 : USB OTG is detected 0 : USB OTG is not detected							
DCP		1 : DCP is detected 0 : DCP is not detected							
CDP		1 : CDP is detected 0 : CDP is not detected							
MHL		1 : MHL is detected 0 : MHL is not detected							
UART		1 : UART is detected 0 : UART is not detected							
SDP		1 : SDP is detected 0 : SDP is not detected							
JIG RF Calibration CP (FM10)		1 : Factory mode cable RF Calibration Mode using CP detected 0 : Factory mode cable RF Calibration Mode using CP not detected							
JIG USB-ON CP (FM11)		1 : Factory mode cable USB path with BOOT ON using CP detected 0 : Factory mode cable USB path with BOOT ON using CP not detected							
0x09	Device Type 2	JIG RF Calibration	JIG Battery Discharge	JIG BAT CHG	JIG MHL BIST	Force-Down wo BAT	JIG UART-ON	Force-Down wi BAT	JIG USB-ON
	Reset Value	0	0	0	0	0	0	0	0
	Read/Write	R	R	R	R	R	R	R	R
JIG RF Calibration (FM7)		1 : Factory mode cable RF Calibration Mode using AP detected 0 : Factory mode cable RF Calibration Mode using AP not detected							
JIG Battery Discharge (FM6)		1 : Factory mode cable Battery Discharge Mode detected 0 : Factory mode cable Battery Discharge Mode not detected							
JIG BAT CHG (FM1)		1 : Factory mode cable Battery Charge Mode detected 0 : Factory mode cable Battery Charge Mode not detected							
JIG MHL BIST (FM9)		1 : Factory mode MHL BIST Mode detected 0 : Factory mode MHL BIST Mode not detected							
Force-Down wo BAT (FM5)		1 : Force-Download Mode without battery detected 0 : Force-Download Mode without battery not detected							
JIG UART-ON (FM4)		1 : Factory mode cable UART path with BOOT ON detected 0 : Factory mode cable UART path with BOOT ON not detected							
Force-Down wi BAT (FM3)		1 : Force-Download Mode with battery detected 0 : Force-Download Mode with battery not detected							
JIG USB-ON (FM2)		1 : Factory mode cable USB path with BOOT ON using AP detected 0 : Factory mode cable USB path with BOOT ON using AP not detected							

Address	Name	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0x0A	Device Type 3	Customer Accessory 7	Customer Accessory 6	Customer Accessory 5	Customer Accessory 4	Customer Accessory 3	Customer Accessory 2	Customer Accessory 1	Phone-Off Current Drain
	Reset Value	0	0	0	0	0	0	0	0
	Read/Write	R	R	R	R	R	R	R	R
Customer Accessory 7		1 : Customer accessory 7 detected 0 : Customer accessory 7 not detected							
Customer Accessory 6		1 : Customer accessory 6 detected 0 : Customer accessory 6 not detected							
Customer Accessory 5		1 : Customer accessory 5 detected 0 : Customer accessory 5 not detected							
Customer Accessory 4		1 : Customer accessory 4 detected 0 : Customer accessory 4 not detected							
Customer Accessory 3		1 : Customer accessory 3 detected 0 : Customer accessory 3 not detected							
Customer Accessory 2		1 : Customer accessory 2 detected 0 : Customer accessory 2 not detected							
Customer Accessory 1		1 : Customer accessory 1 detected 0 : Customer accessory 1 not detected							
Phone-Off Current Drain (FM8)		1 : Phone-Off Current Drain Test Mode detected 0 : Phone-Off Current Drain Test Mode not detected							
0x0B	Manual SW 1	DM_CON Switching			DP_CON Switching			ID_CON Switching	
	Reset Value	0	0	0	0	0	0	0	0
	Read/Write	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
DM_CON Switching		000 : Open all switches 001 : DM_CON connected to DM_USB1 010 : DM_CON connected to DM_USB2 011 : DM_CON connected to TxD of UART 100 : DM_CON connected to MHL_D- 101-111: not used							
DP_CON Switching		000 : Open all switches 001 : DP_CON connected to DP_USB1 010 : DP_CON connected to DP_USB2 011 : DP_CON connected to RxD of UART 100 : DP_CON connected to MHL_D+ 101-111: not used							
ID_CON Switching		00 : Open all switches 01 : ID_CON connected to VBAT (only allow in factory mode) 10 : ID_CON connected to ID_BYP 11 : ID_CON connected to CBUS							

Address	Name	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0x0C	Manual SW 2	Reserved	Reserved	Reserved	Reserved	Reserved	CHGDET	BOOT_SW	JIG_ON
	Reset Value	0	0	0	0	0	0	1	1
	Read/Write	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
CHG_DET		0 : High impedance (Disable) 1 : Low (Enable)							
BOOT_SW		0 : Low (Enable) 1 : High impedance (Disable)							
JIG_ON		0 : High (Disable) 1 : Low (Enable)							
0x0D	Timing Set 2	INTB Watchdog		DCD Timeout Set		CHGDET On Time	Phone-Off Wait Time		
	Reset Value	0	0	0	1	1	0	0	0
	Read/Write	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
INTB Watchdog		00 : Disable Watchdog function 01 : 250ms 10 : 500ms 11 : 1000ms							
DCD Timeout Set		00 : 300ms 01 : 600ms 10 : 900ms 11 : 1200ms							
CHGDET On Time		0 : 150ms 1 : 300ms							
Phone-Off Wait Time		The timing is used only for FM8 000 : 50ms 001 : 100ms 010 : 150ms 011 : 200ms 100 : 250ms 101 : 300ms 110 : 350ms 111 : 400ms							
0x0E	MUIC Control 2	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	FM1 Enable	DCD Timeout EN
	Reset Value	0	0	0	0	0	0	0	1
	Read/Write	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
FM1 Enable		0 : Disable Factory Mode 1 1 : Enable Factory Mode 1							
DCD Timeout EN		0 : Disable DCD Timeout 1 : Enable DCD Timeout							

Address	Name	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0x0F	Device Type 4	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
	Reset Value	0	0	0	0	0	0	0	0
	Read/Write	R	R	R	R	R	R	R	R
0x10	MUIC Control 3	VBUS_PD	Reserved	OVP SEL		ID Floating Deglitch		Reserved	Reserved
	Reset Value	0	0	0	1	1	0	0	0
	Read/Write	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
VBUS_PD		0 : Disable discharging ability 1 : Enable discharging ability							
OVP SEL		00 : 6.2V 01 : 6.8V 10 : 11.5V 11 : 14.5V							
ID Floating Deglitch		Floating deglitch (Pull-down time after detection is done) 00 : 5ms (50ms) 01 : 10ms (75ms) 10 : 20ms (100ms) 11 : 40ms (150ms)							
0x11	MUIC Control 4	Reserved	Reserved	Reserved	IDFET_OCP OFF	Reserved	Reserved	SWEN_IDBAT1	SWEN_IDBAT2
	Reset Value	0	0	0	0	0	0	1	1
	Read/Write	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
IDFET_OCP OFF		0 : Enable IDCON to VBAT FET OCP function 1 : Disable IDCON to VBAT FET OCP function							
SWEN_IDBAT1		0 : Disable IDCON1 to VBAT Switch function (always open) 1 : Enable IDCON1 to VBAT Switch function (can be controlled)							
SWEN_IDBAT2		0 : Disable IDCON2 to VBAT Switch function (always open) 1 : Enable IDCON2 to VBAT Switch function (can be controlled)							

Address	Name	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0x12	MUIC Status 1	Reserved	Reserved	FMEN	CHGDET	DCDT	VIN UVLO	Reserved	VIN OVP
	Reset Value	0	0	0	0	0	0	0	0
	Read/Write	R	R	R	R	R	R	R	R
FMEN		0 : Not entering FM Mode 1 : Entering FM Mode							
CHGDET		0 : Charger port is not detected 1 : Charger port is detected							
DCDT		0 : DCD Timeout event of BC detection not occurs 1 : DCD Timeout event of BC detection occurs							
UVLO		0 : VBUS UVLO does not occur with 128μs deglitch 1 : VBUS UVLO occurs with 128μs deglitch							
OVP		0 : VBUS OVP does not occur with 128μs deglitch 1 : VBUS OVP occurs with 128μs deglitch							
0x13	MUIC Status 2	Reserved	USB Status			Reserved	Reserved	ID Status	
	Reset Value	0	0	0	0	0	0	0	0
	Read/Write	R	R	R	R	R	R	R	R
USB Status		000 : No VBUS 001 : VBUS flow is under going 010 : SDP 011 : SDP NSTD 100 : DCP 101 : CDP 110 : reserved 111 : reserved							
ID Status		00 : ID detection open (idle with ADC = 1F) 01 : ID detection is under-going (not idle) 10 : ID detection is under periodical mode (idle) 11 : ID detection is stable (idle with ADC is not 1F)							
0x18	ADC	Reserved	Reserved	Reserved	ADC Value				
	Reset Value	0	0	0	0	0	0	0	0
	Read/Write	R	R	R	R	R	R	R	R
ADC Value		ADC value by ID detection results (after ID stable time)							
0x19	Reset	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reset
	Reset Value	0	0	0	0	0	0	0	0
	Read/Write	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W/C
Reset		0 : Not reset entire IC 1 : Reset entire IC and clear to 0 after reset							

Accessory Detection

The RT8979 has a 5-Bit ADC to detect resistance of ID pin. VBUS plug-in can be also detected and applied battery charger detection 1.2 (BC1.2) for determining the types of adaptor. According to the VBUS & RID ADC detection results, the RT8979 will configure the switches (USB1, USB2, UART and MHL) and related function (JIG and BOOT in factory mode).

IO Buffers (INTB, JIG, BOOT, CHGDET)

The voltage level of INTB is initially low when power-up, and goes to high level when register INTMASK is written to 0. After INTB stays high, if any events occurs, the INTB will be falling down to inform the system to get interrupt information. JIG and BOOT pins are functioned only when factory mode operation. CHGDET will be low when the results of BC1.2 are dedicated charging port (DCP) or charging downstream port (CDP).

ID_CON FET

The ID_CON FET (From ID_CON1/2 to VBAT) operates only when entering factory mode. The FET can provide at least 3A in application with R_{ON} of 50mΩ. The FET has an OCP soft-start of 32ms to prevent large inrush current when turning on.

Thermal Considerations

The junction temperature should never exceed the absolute maximum junction temperature $T_{J(MAX)}$, listed under Absolute Maximum Ratings, to avoid permanent damage to the device. The maximum allowable power dissipation depends on the thermal resistance of the IC package, the PCB layout, the rate of surrounding airflow, and the difference between the junction and ambient temperatures. The maximum power dissipation can be calculated using the following formula :

$P_{D(MAX)} = (T_{J(MAX)} - T_A) / \theta_{JA}$

where $T_{J(MAX)}$ is the maximum junction temperature, T_A is the ambient temperature, and θ_{JA} is the junction-to-ambient thermal resistance.

For continuous operation, the maximum operating junction temperature indicated under Recommended Operating Conditions is 125°C. The junction-to-ambient thermal resistance, θ_{JA}, is highly package dependent. For a WL-CSP 25B 2.07x2.07 (BSC) package, the thermal resistance, θ_{JA}, is 35.6°C/W on a standard JEDEC 51-7 high effective-thermal-conductivity four-layer test board. The maximum power dissipation at T_A = 25°C can be calculated as below :

$P_{D(MAX)}$ = (125°C – 25°C) / (35.6°C/W) = 2.8W for a WL-CSP 25B 2.07x2.07 (BSC) package.

The maximum power dissipation depends on the operating ambient temperature for the fixed $T_{J(MAX)}$ and the thermal resistance, θ_{JA}. The derating curves in Figure 1 allows the designer to see the effect of rising ambient temperature on the maximum power dissipation.

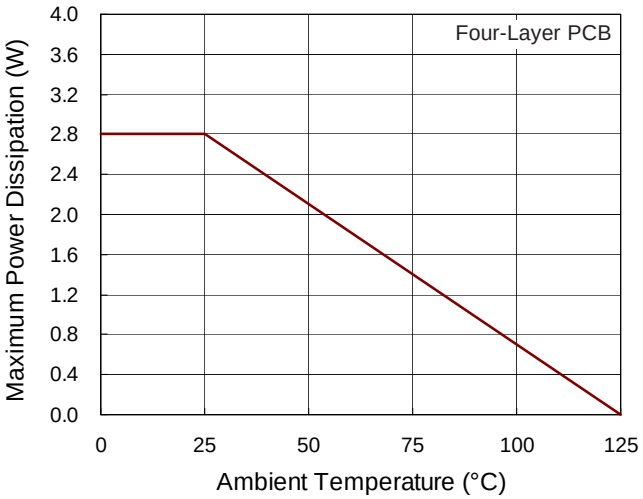
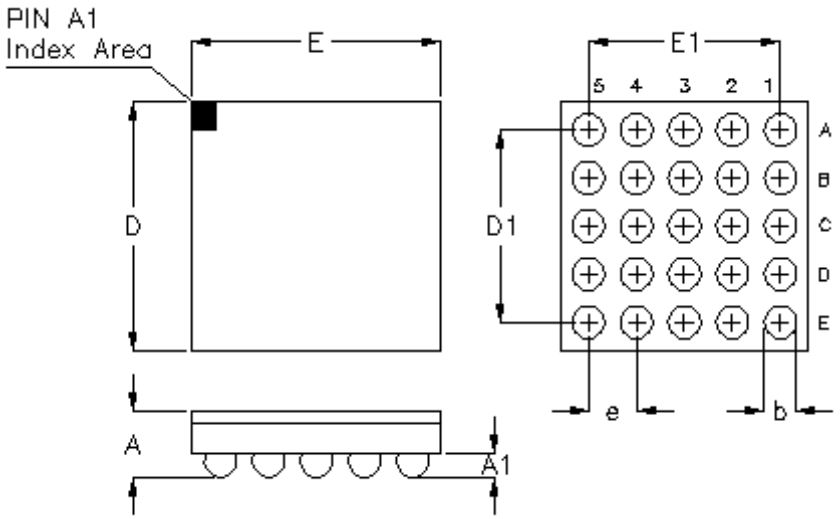


Figure 8. Derating Curve of Maximum Power Dissipation

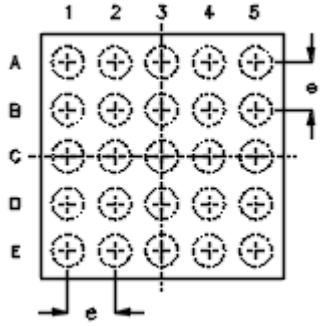
Outline Dimension



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.500	0.600	0.020	0.024
A1	0.170	0.230	0.007	0.009
b	0.240	0.300	0.009	0.012
D	2.020	2.120	0.080	0.083
D1	1.600		0.063	
E	2.020	2.120	0.080	0.083
E1	1.600		0.063	
e	0.400		0.016	

25B WL-CSP 2.07x2.07 Package (BSC)

Footprint Information



Package	Number of Pin	Type	Footprint Dimension (mm)			Tolerance
			e	A	B	
WL-CSP2.07*2.07-25(BSC)	25	NSMD	0.400	0.240	0.340	±0.025
		SMD		0.270	0.240	

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