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FSA9280A

USB Port Multimedia Switch Featuring Automatic Select and Accessory Detection

Features

Signals	Audio, USB, UART, USB Charging
Switch Mechanism	Automatic Switching with Available Interrupt
Accessory Detection	Headsets (Headphone/MIC/Remote) USB Data Port (SDP) UART Serial Link USB Chargers (Car-Kit, CDP, DCP) Factory-Mode TTY Converter
USB	FS and HS 2.0 Compliant
USB Charging	Battery Charging 1.1 Compliant (Including Optional DCD) Integrated Power FET Over-Voltage Tolerance (OVT) 28V Over-Current Protection (OCP) 1.5A Over-Voltage Protection (OVP) 6.8V
Audio	Left, Right, MIC, TTY
V_{BAT}	3 to 4.4V
Programmability	I ² C
ESD	15kV IEC 61000-4-2 Air Gap
Package	20-Lead UMLP (3 x 4 x 0.55mm, 0.5mm Pitch)
Ordering Information	FSA9280AUMX

Description

The FSA9280A is a high-performance multimedia switch featuring automatic switching and accessory detection for the USB port. This switch allows sharing of a common USB port to pass audio, USB data / charging, as well as factory programmability. In addition, the FSA9280A integrates detection of accessories; such as headphones, headsets (MIC / button), car chargers, USB chargers, and UART data cables; with the ability to use a common USB connector. The FSA9280A can be programmed for manual or automatic switching of data paths based on accessory detected. FSA9280A includes an integrated 28V over-voltage and 1.5A over-current protected FET.

Applications

- Mobile Phones & Portable Media Players

Related Resources

- FSA9280A Evaluation Board
- Evaluation Board Users Guide
- For samples, questions or board requests; please contact analogswitch@fairchildsemi.com

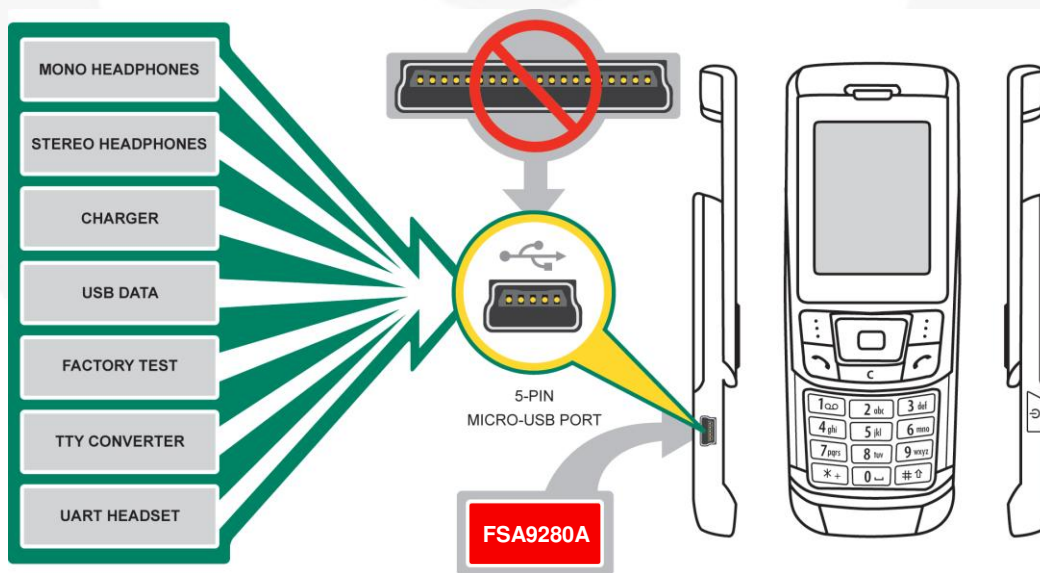


Figure 1. Typical Application

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Block Diagram

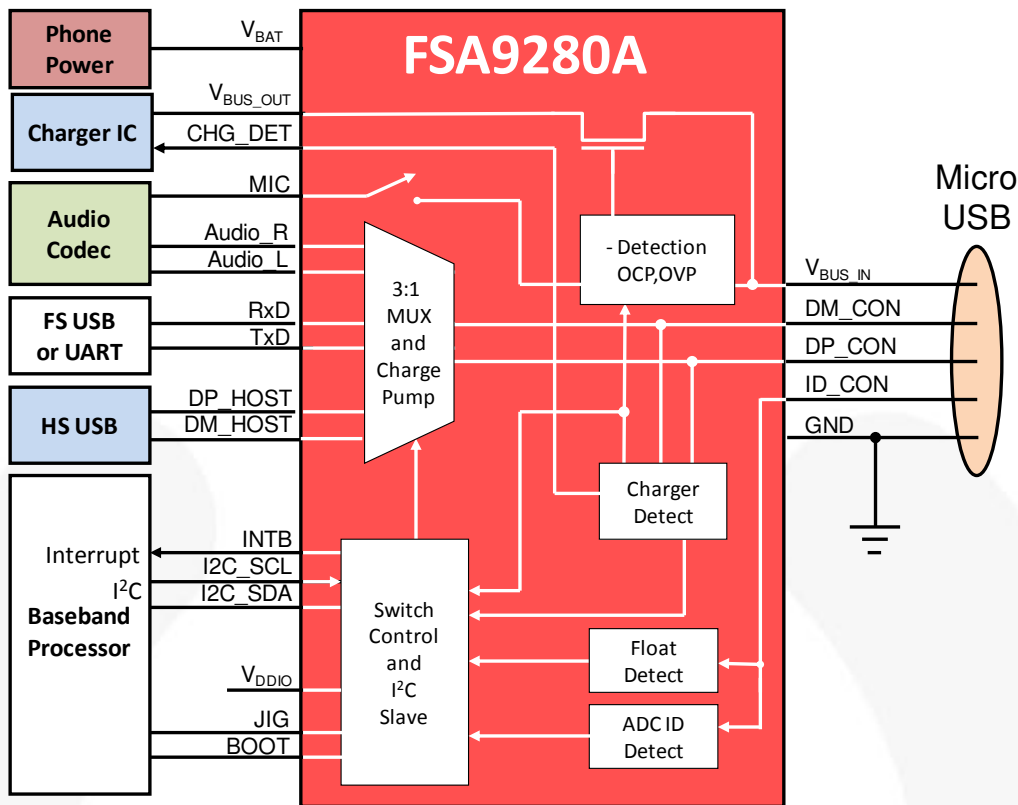


Figure 2. Block Diagram

Pin Configuration

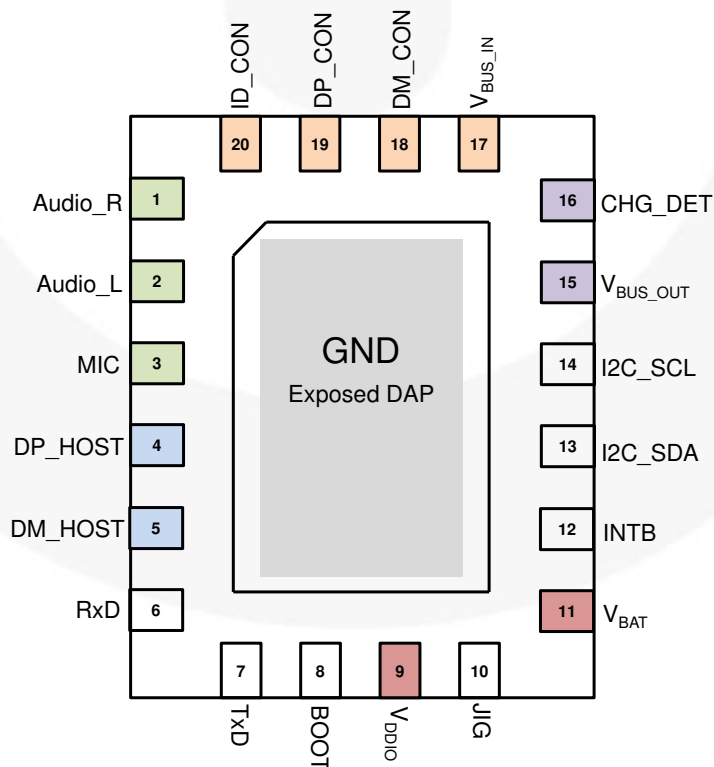


Figure 3. Pin Assignments (Top View)

Pin Descriptions

Name	Pin #	Type	Default State	Description
USB Interface				
DP_HOST	4	Signal Path	Open	D+ signal switch path, dedicated USB port to be connected to the resident USB transceiver on the phone
DM_HOST	5	Signal Path	Open	D- signal switch path, dedicated USB port to be connected to the resident USB transceiver on the phone
Audio Interface				
Audio_L	2	Signal Path	Open	Left audio channel from mobile phone audio-out CODEC
Audio_R	1	Signal Path	Open	Right audio channel from mobile phone audio-out CODEC
MIC	3	Signal Path	Open	Connected to the mobile phone audio CODEC MIC input pin
UART Interface				
TxD	7	Signal Path	Open	Transmitter (Tx) from resident UART on the mobile phone
RxD	6	Signal Path	Open	Receiver (Rx) from resident UART on the mobile phone
Connector Interface				
ID_CON	20	Signal Path	Open	Connected to the USB connector ID pin and used for detecting accessories or button presses
DP_CON	19	Signal Path	Open	Connected to the USB connector D+ pin; depending on the signaling mode, this pin can be switched to DP_HOST, Audio_R, or RxD pins
DM_CON	18	Signal Path	Open	Connected to the USB connector D- pin; depending on the signaling mode, this pin can be switched to DM_HOST, Audio_L, or TxD pins
V _{BUS_IN}	17	Power Path	N/A	Input voltage supply pin to be connected to the V _{BUS} pin of the USB connector
Power Interface				
V _{BAT}	11	Power	N/A	Input voltage supply pin to be connected to the mobile phone battery output or to an internal regulator on the phone
V _{DDIO}	9	Power	N/A	Baseband processor interface I/O supply pin
GND	Exposed Center Pad	Ground	N/A	Ground (center ground pad of package makes electrical contact)
Charger Interface				
V _{BUS_OUT}	15	Power Path	N/A	Output voltage supply pin to be connected to the source voltage pin on the charger IC
CHG_DET	16	Open-Drain Output	Hi-Z	Open-drain active LOW output, used to signal the charger IC that a charger has been attached
Factory Interface				
JIG	10	Open-Drain Output	Hi-Z	Output control signal driven by the FSA9280A and used by the processor for factory test modes
BOOT	8	CMOS Output	LOW	Output control signal driven by the FSA9280A and used by the processor for factory test modes
I²C Interface				
I ² C_SCL	14	Input	Hi-Z	I ² C serial clock signal to be connected to the phone-based I ² C master
I ² C_SDA	13	Open-Drain I/O	Hi-Z	I ² C serial data signal to be connected to the phone-based I ² C master
INTB	12	CMOS Output	LOW	Interrupt active LOW output used to prompt the phone baseband processor to read the I ² C register bits, indicates a change in ID_CON pin status or accessory attach status

1. Functionality

The FSA9280A offers a complete solution for a single 5-pin USB interface. Through built-in detection algorithms that monitor the ID and V_{BUS} pins of the USB interface, the FSA9280A allows seamless sharing of the interface between HS USB, FS USB or UART, and audio sources. The FSA9280A also offers a complete solution for multiple types of USB chargers. The FSA9280A detects different USB charger types and has a dedicated charger IC interface to allow charging through the devices and dynamic current control by the charger IC based on the type of charger detected. Additional over-current protection (OCP) and up to 28V over-voltage tolerance (OVT) is provided.

The detection features are capable of monitoring the ID pin of the USB interface to detect a full array of USB accessories, including audio accessories with up to 12 buttons.

1.1. Functional Overview

The FSA9280A is designed for minimal software requirements for proper operation. The flow diagram below shows the basic steps of operation and contains references to more detailed information.

Flow Diagram	State	Datasheet Section	Description
<pre> graph TD A[Power-up & Reset] --> B[I2C] B --> C[Configuration] C --> D[Accessory Plug-in] D --> E[Detection] E --> F[Processor Communication] F --> G[Switch Configuration] G --> H[Active Signals] H --> I[Accessory Detached] I --> D </pre>	Power-up & Reset	Section 2	Applying power to the device and reset states of the device.
	I²C	Section 3	Communication with device through I ² C (which can be bypassed during power-up).
	Configuration	Section 4	Configuring the device using I ² C and the internal registers (which can be bypassed during power-up).
	Detection	Section 5	How the detection of the accessory is done including attachment and detachment.
	Processor Communication	Section 6	How the detection of the accessory is indicated to the processor.
	Switch Configuration	Section 7	Configuration of switches based on detection.
	Active Signal	Section 8	Signal performance of selected configuration

2. Power-up & Reset

The FSA9280A does not need special power sequencing for correct operation. The main power of the device is provided by either V_{BUS_IN} or V_{BAT} . If V_{BUS_IN} is not present and V_{BAT} is applied, V_{BAT} is used to power the device. V_{DDIO} is only used for I²C interface and interrupt processing.

Table 1 summarizes the enabled features of each power state of the FSA9280A. The valid voltages levels for each power supply can be found in Section 9.2.

Table 1 – Power States Summary

Valid V_{BUS_IN}	Valid V_{BAT}	Valid $V_{DDIO}^{(1)}$	Power State	Enabled Functionality		
				Charging through FET	Processor Communication (I ² C & Interrupts)	Detection
NO	NO	NO	Power Down	NO	NO	NO
NO	NO	YES ⁽²⁾		ILLEGAL STATE		
NO	YES	NO	Powered from V_{BAT}	NO	NO	YES
NO	YES	YES	Powered from V_{BAT}	NO	YES	YES
YES	NO	NO	Powered from V_{BUS_IN}	Yes	NO	YES
YES	YES	NO	Powered from V_{BAT}	YES	NO	YES
YES	NO	YES ⁽²⁾	Powered from V_{BUS_IN}	YES	YES	YES
YES	YES	YES	Powered from V_{BAT}	YES	YES	YES

Notes:

- V_{DDIO} is expected to be the same supply used by the baseband I/O's.
- This is not a typical state: both V_{BAT} and V_{DDIO} are typically provided simultaneously.

2.1. Reset

When the device is reset, all the registers are initialized to the default values shown in Table 7 and all switch paths are open. After reset or power up, the FSA9280A enters Standby Mode and is ready to detect accessories sensed on its V_{BUS_IN} and / or ID_CON pins.

2.1.1. Hardware Reset

There are three hardware reset mechanisms:

- Power-on reset caused by the initial rising edge of V_{BUS} or V_{BAT}
- The falling edge of V_{DDIO} .

- With V_{DDIO} valid, driving both I2C_SDA and I2C_SCL signals LOW for at least 30ms.

Note:

- I²C controllers that implement clock stretching could cause reset. In this case, GPIOs could be used for the I²C interface.

2.1.2. Software Reset

The device can be reset through software by writing to the Reset bit in the Register (1BH).

3. I²C

The FSA9280A integrates a fast-mode I²C slave controller compliant with the I²C specification version 2.1 requirements. The FSA9280A I²C interface runs up to 400KHz.

The slave address is shown in Table 2. Status information and configuration occurs via the I²C interface.

Please see Section 9.7 for more information.

Table 2 – I²C Slave Address

Name	Size (Bits)	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Slave Address	8	0	1	0	0	1	0	1	Read / Write

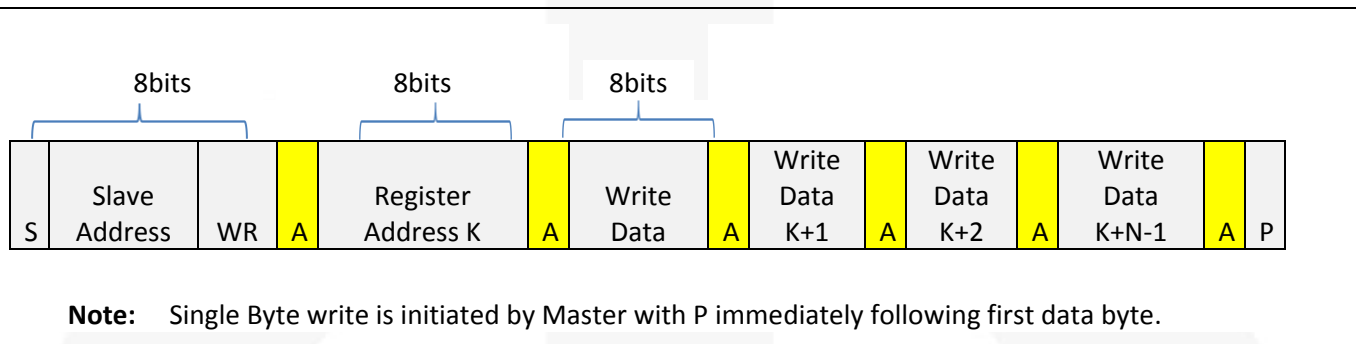


Figure 4. I²C Write Sequence

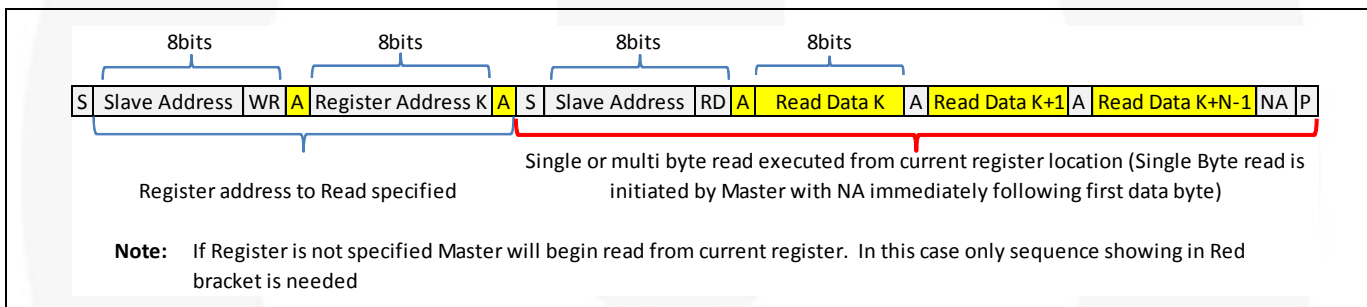


Figure 5. I²C Read Sequence

	From Master to Slave	S	Start Condition	NA	NOT Acknowledge (SDA High)	RD	Read =1
	From Slave to Master	A	Acknowledge (SDA Low)	WR	Write=0	P	Stop Condition

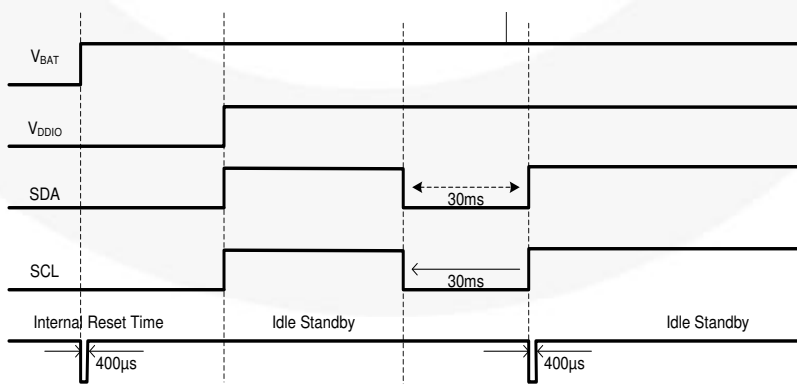


Figure 6. I²C Reset Mode Timing

The FSA9280A monitors both V_{BUS_IN} and ID_CON to detect accessories. The ID_CON detection is a “resistive detection” that detects the resistance to GND on the ID_CON pin to

determine which accessory is attached. Table 3 shows the assignment of accessories based on resistor values.

Table 3. ID_CON Accessory Detection

Binary Value ⁽⁴⁾	ID_CON Resistance to GND			Accessory Detected ⁽⁵⁾
	Min.	Typ.	Max.	
00000	GND	GND	GND	DO NOT USE
00001	1.9k Ω	2.0k Ω	2.1k Ω	Audio Send/End Button
00010	2.470k Ω	2.604k Ω	2.730k Ω	Audio Remote S1 Button ⁽⁶⁾
00011	3.050k Ω	3.208k Ω	3.370k Ω	Audio Remote S2 Button ⁽⁶⁾
00100	3.810k Ω	4.014k Ω	4.210k Ω	Audio Remote S3 Button ⁽⁶⁾
00101	4.58k Ω	4.82k Ω	5.06k Ω	Audio Remote S4 Button ⁽⁶⁾
00110	5.73k Ω	6.03k Ω	6.33k Ω	Audio Remote S5 Button ⁽⁶⁾
00111	7.63k Ω	8.03k Ω	8.43k Ω	Audio Remote S6 Button ⁽⁶⁾
01000	9.53k Ω	10.03k Ω	10.53k Ω	Audio Remote S7 Button ⁽⁶⁾
01001	11.43k Ω	12.03k Ω	12.63k Ω	Audio Remote S8 Button ⁽⁶⁾
01010	13.74k Ω	14.46k Ω	15.18k Ω	Audio Remote S9 Button ⁽⁶⁾
01011	16.40k Ω	17.26k Ω	18.12k Ω	Audio Remote S10 Button ⁽⁶⁾
01100	19.48k Ω	20.50k Ω	21.53k Ω	Audio Remote S11 Button ⁽⁶⁾
01101	22.87k Ω	24.07k Ω	25.27k Ω	Audio Remote S12 Button ⁽⁶⁾
01110	27.27k Ω	28.70k Ω	30.14k Ω	Reserved Accessory #1
01111	32.3k Ω	34.0k Ω	35.7k Ω	Reserved Accessory #2
10000	38.19k Ω	40.20k Ω	42.21k Ω	Reserved Accessory #3
10001	47.41k Ω	49.90k Ω	52.40k Ω	Reserved Accessory #4
10010	61.66k Ω	64.90k Ω	68.15k Ω	Reserved Accessory #5
10011	76.1k Ω	80.7k Ω	84.1k Ω	DO NOT USE
10100	96.9k Ω	102.0k Ω	107.1k Ω	DO NOT USE
10101	115k Ω	121k Ω	127k Ω	TTY Converter
10110	143k Ω	150k Ω	157k Ω	UART Cable
10111	190k Ω	200k Ω	206k Ω	USB: See Table 4
11000	247.3k Ω	255k Ω	262.7k Ω	Factory Mode Boot OFF-USB
11001	292k Ω	301k Ω	310k Ω	Factory Mode Boot ON-USB
11010	347k Ω	365k Ω	383k Ω	Audio Cradle
11011	428.7k Ω	442.0k Ω	455.3k Ω	USB: See Table 4
11100	507.3k Ω	523k Ω	538.7k Ω	Factory Mode Boot OFF-UART
11101	600.4k Ω	619k Ω	637.6k Ω	Factory Mode Boot ON-UART
11110	750k Ω	1000k Ω	1050k Ω	Audio Type 1 with Remote ⁽⁸⁾
	750k Ω	1002k Ω	1050k Ω	Audio Type 1 / Only Send-End ⁽⁸⁾
11111	20M Ω ⁽⁷⁾	Open ⁽⁷⁾		USB Mode, Dedicated Charger or Accessory Detach

Notes:

- The binary values are reported in the binary register (07h) with each valid accessory detection.
- The accessory type is reported in the Device Type 1 (0Bh), Device Type 2 (0Bh), Button 1 (0Ch), and Button 2 (0Dh) registers with each valid accessory detection.
- These resistor values are created by multiple standard resistor values in series to form the button presses on the wired remote (see Figure 12).
- For the ID float, ID “open” is recommended; otherwise, capacitance should be minimized.
- Audio devices with remote and audio devices with only send/end are both reported as Audio Type 1 in the Device Type 1 register (see the Audio Accessory Detection section below). Type 1 is for passive resistor audio accessories and a future Audio Type 2 is designated for active audio accessories.

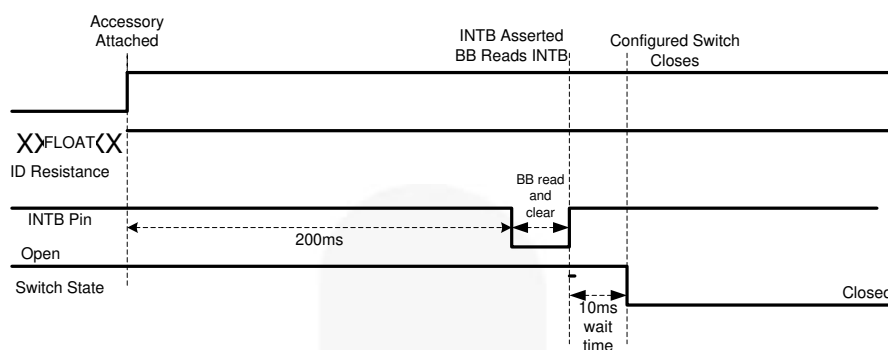


Figure 8. ID-Based Accessories, No V_{BUS_IN} Attach Timing with Default Switching Wait Bits of 10ms

5.1. USB Port Detection

The multiple types of USB 2.0 ports that the FSA9280A can detect are summarized in Table 4. These devices are unique in that V_{BUS} must be present to detect these accessories.

Table 4. ID_CON and V_{BUS_IN} Detection for USB Devices

ADC Value ⁽⁹⁾	V_{BUS_IN}	DP_CON	DP_CON	ID_CON Resistance to GND			Accessory Detected ⁽¹⁰⁾
				Min.	Typ.	Max.	
10111	5V	X	X	190k Ω	200k Ω	206k Ω	Car Kit Type 1 Charger ⁽¹¹⁾
11011	5V	X	X	428.7k Ω	442k Ω	455.3k Ω	Car Kit Type 2 Charger ⁽¹¹⁾
11111	5V	(12)	(12)	20M Ω	Open	Open	USB Dedicated Charging Port, Travel Adapter or Dedicated Charger (DCP)
11111	5V	(12)	(12)	20M Ω	Open	Open	USB Charging Downstream Port (CDP)
11111	5V	(12)	(12)	20M Ω	Open	Open	USB Standard Downstream Port (SDP)

Notes:

9. The ADC values are reported in the ADC register (07h) with an each valid accessory detection.
10. The accessory type is reported in the Device Type 1 (0Bh) and Car Kit Status (0Eh) registers with an each valid accessory detection.
11. Follows the ANSI/CEA-936-A USB Car Kit specification.
12. The FSA9280A follow the Battery Charging 1.1 specification, which uses DP_CON and DM_CON to determine what USB accessory is attached (*refer to the specification for details*).

The following figures show the attach timing of the USB accessories and the relationship between the INTB assertion and the CHG_DET assertion. FSA9280A implements the optional data contact detection (DCD) feature of the USB Battery Charging specification. The DCD detection ensures

proper connection of the DP_CON and DM_CON before starting the USB charging detection scheme. This feature allows for shorter attach times by eliminating long wait times to allow full contact of the DP_CON and DM_CON pins.

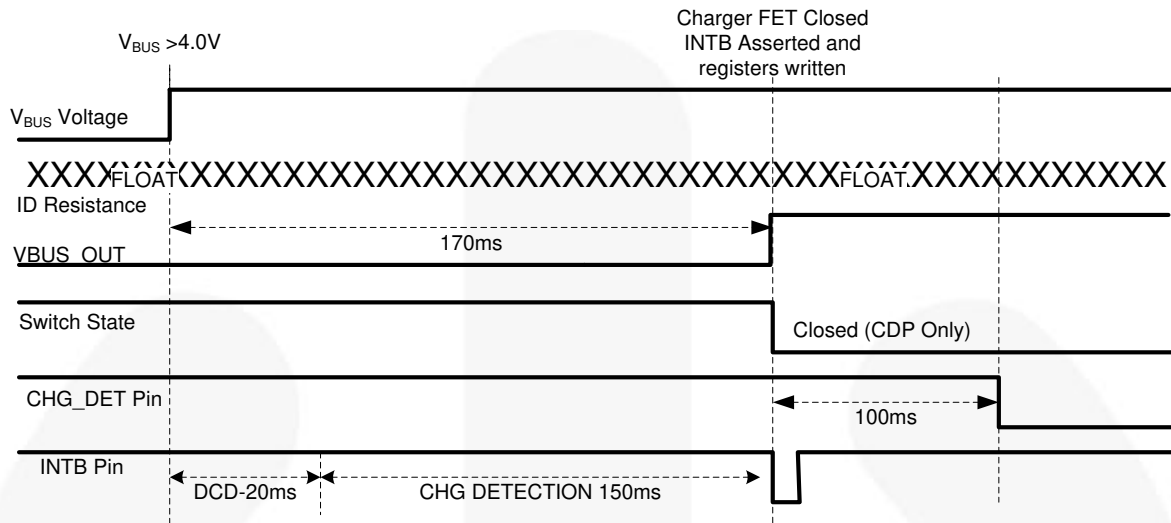


Figure 9. USB Dedicated Charging Port (DCP) or Charging Downstream Port (CDP) Attach Timing

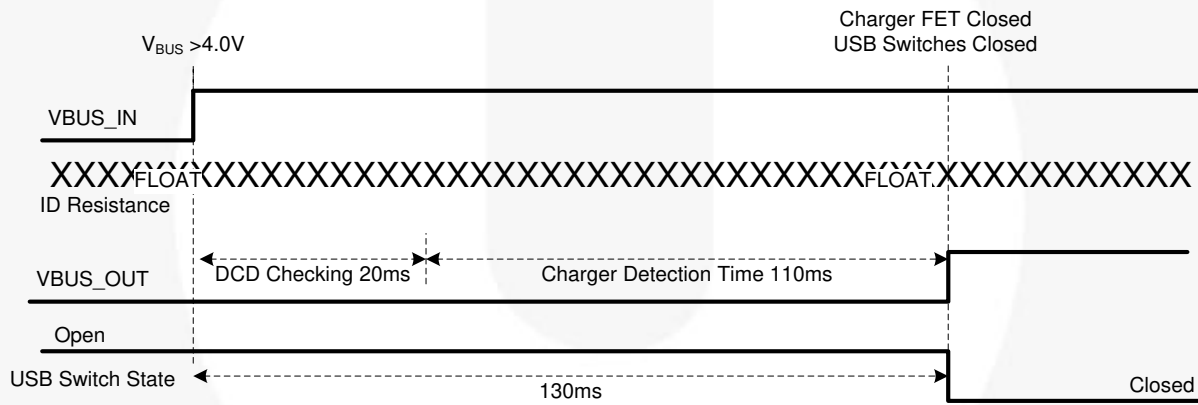


Figure 10. USB Standard Downstream Port Attach Timing

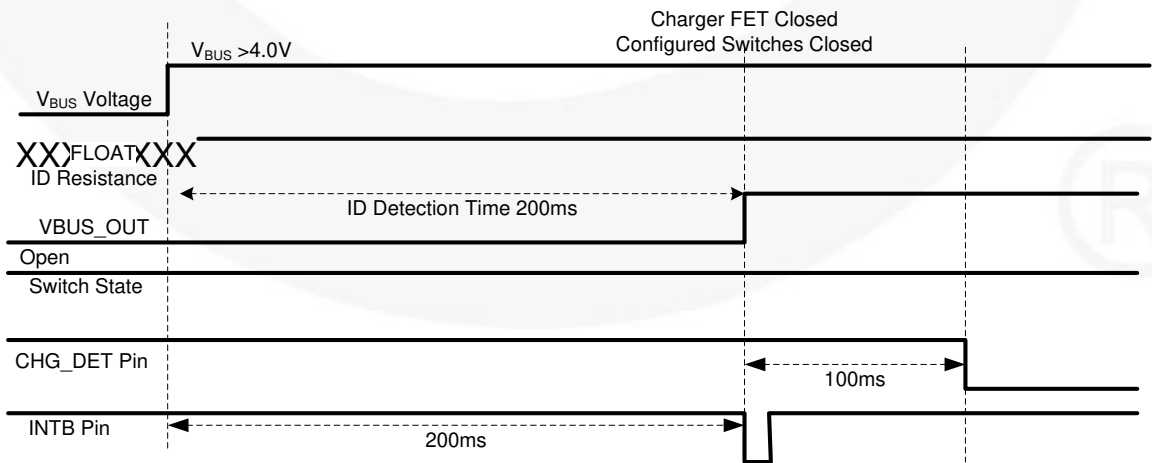


Figure 11. Car Kit Type 1 and 2 Attach Timing

5.2. Audio Accessory Detection

Audio accessories are detected when the ID_CON pin resistance to GND is approximately 1MΩ. Configurations for this audio accessory shown in Figure 12 and Figure 13.

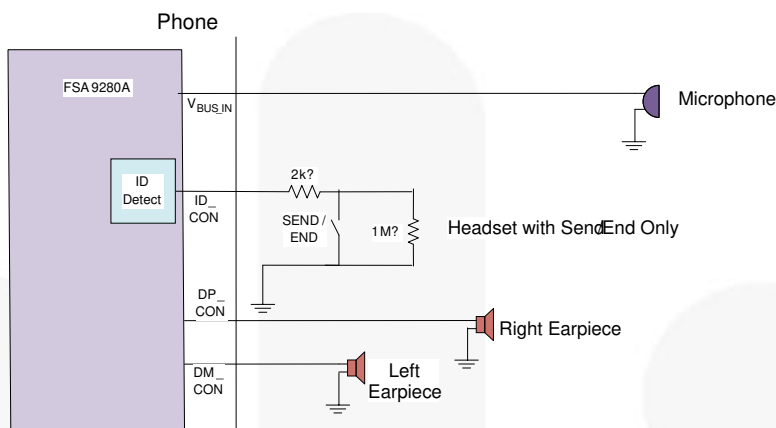


Figure 12. Audio Accessory with Just Send/End Button (1% or 5% Resistors)

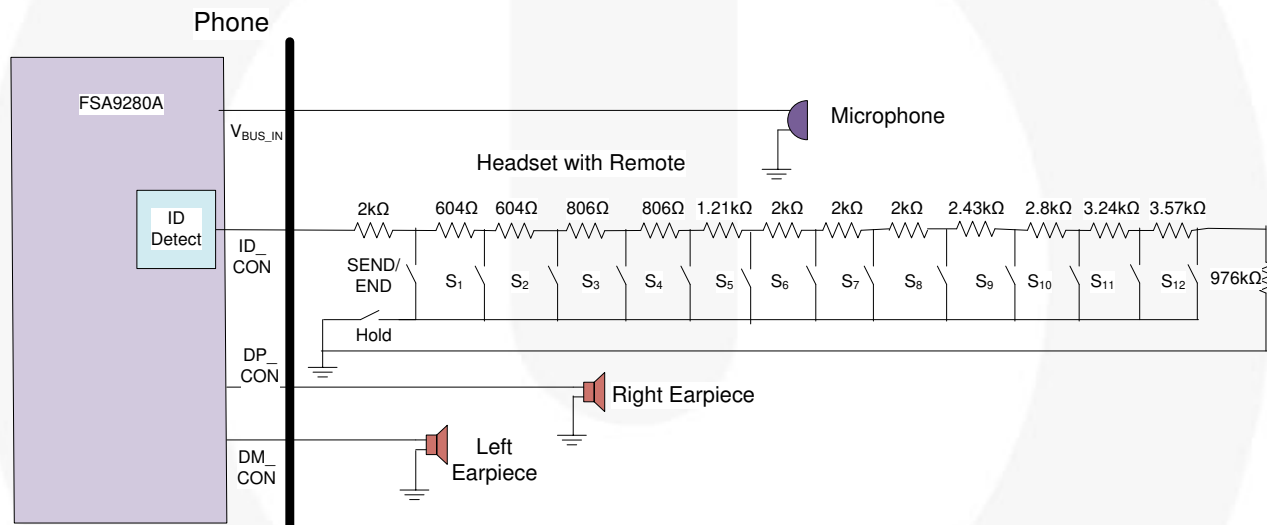


Figure 13. Audio Accessory with Full Wired Remote Control (1% Resistors)

The FSA9280A can detect and differentiate between regular key presses, long key presses, and a stuck key. The definition of the key press timing is user configurable by

writing the Timing Set 1 (08h) and Timing Set 2 (09h) registers. Timing diagrams for the key press detection are shown below in Figure 14 and Figure 15.

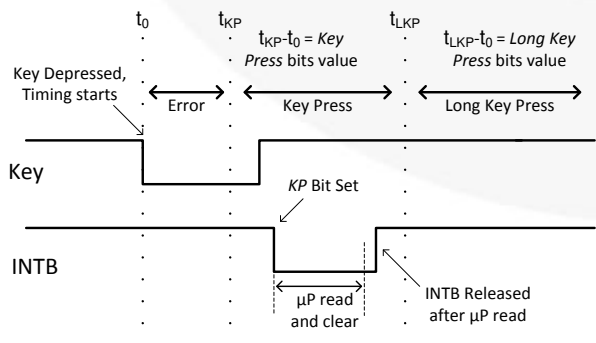


Figure 14. Regular Key-Press Timing Diagram

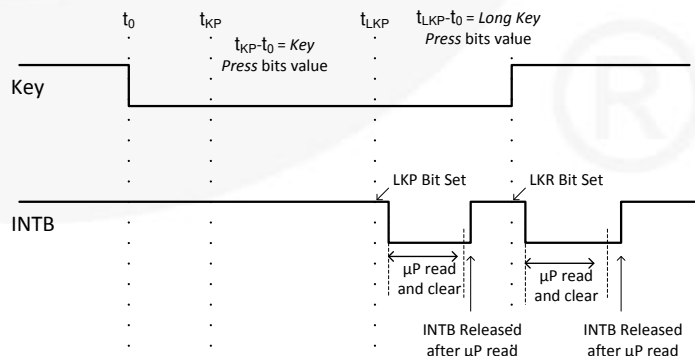


Figure 15. Long Key-Press Timing Diagram

5.3. OCP and OVP Detection

With V_{BUS_IN} greater than 6.8V, V_{BUS_IN} is disconnected, protecting the FSA9280A and all application circuitry from excess voltage. This block is capable of withstanding continuous 28V in Shutdown Mode. Upon entering Shutdown Mode, the OVP_EN bit in the Interrupt 1 register is set HIGH and an interrupt is sent to the baseband. The Over-Current Protection (OCP) feature limits current through the charger FET to $\leq 1.5A$. The FSA9280A automatically senses an over-current event, shuts down V_{BUSOUT} , and reports this to the baseband by asserting OCP_EN in the Interrupt 1 register. OCP Mode is only implemented when V_{BUS_IN} is provided by the attached accessory. Removal of an OVP or OCP condition triggers another interrupt sent to the processor clearing the OCP_EN and/or the OVP_EN bits and setting the OCP_OVP_DIS bit in the Interrupt 1 register.

6. Processor Communication

Typical communication steps between the processor and the FSA9280A during accessory detection are:

1. INTB asserted LOW, indicating change in accessory detection.
 - a) CHG_DET asserted LOW if USB charger detected.
2. Processor reads Interrupt registers to determine which event occurred.
 - a) Interrupt 1 (03h): Indicates if an attach, detach, key press, long key press, long key release, OVP / OCP event, or OVP / OCP event recovery was detected. Each bit can be masked by setting the corresponding bit in the Interrupt Mask 1 (05h) register.
 - b) Interrupt 2 (04h): Indicates if a reserved accessory, ADC change, stuck key, or stuck key recovery was detected. Each bit can be masked by setting the corresponding bit in the Interrupt Mask 2 (06h) register.
3. Processor reads Status registers to determine exact accessory detected.
 - a) Device Type 1 (0Ah): Indicates which USB, Car Kit UART, or audio accessory was detected.
 - b) Device Type 2 (0Bh): Indicates which factory mode was detected or if a TTY cable was detected.
 - c) Button 1 (0Ch & 0Dh): Indicates which button press was detected with Audio Type 1 accessories.
 - d) Car Kit Status (0Eh): Indicates which type of car kit charger was detected.

6.1. Interrupts

The baseband processor recognizes interrupt signals by observing the INTB signal, which is active LOW. Interrupts are masked upon reset or power up via the INT Mask register bit (bit 0 of Control register, address 02h in Table 7. Register Map) and INTB pin defaults LOW right after this reset or power up. After the INT Mask bit is cleared by the baseband processor, the INTB pin is driven HIGH in preparation for a future interrupt. When an interruptible event

occurs, INTB transitions LOW and returns HIGH when the processor reads the Interrupt register at address 03h. Subsequent to the initial power up or reset; if the processor writes a "1" to INT Mask bit when the system is already powered up, the INTB pin stays HIGH and ignores all interrupts until the INT Mask bit is cleared. If an event happens that would ordinarily cause an interrupt when the INT Mask bit is set, the INTB pin is LOW for t_{INT_MASK} after the INT Mask bit is cleared.

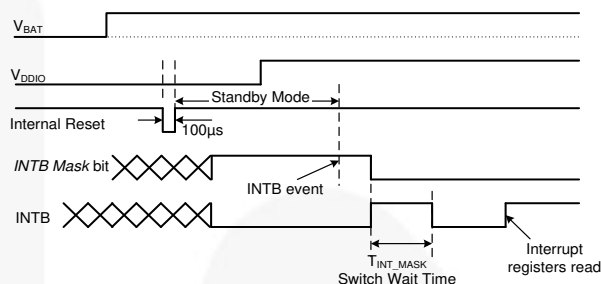


Figure 16. Power-up Interrupt Timing Diagram

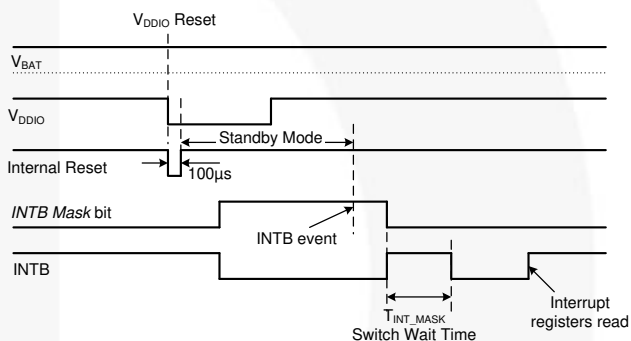


Figure 17. V_{DDIO} Reset Interrupt Timing Diagram

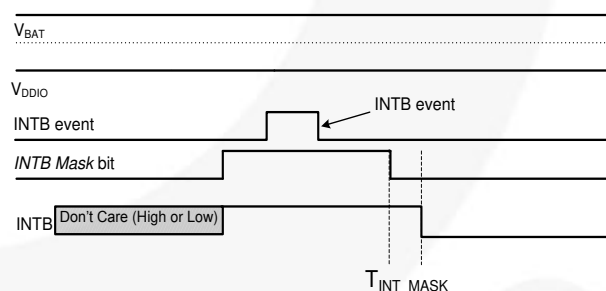
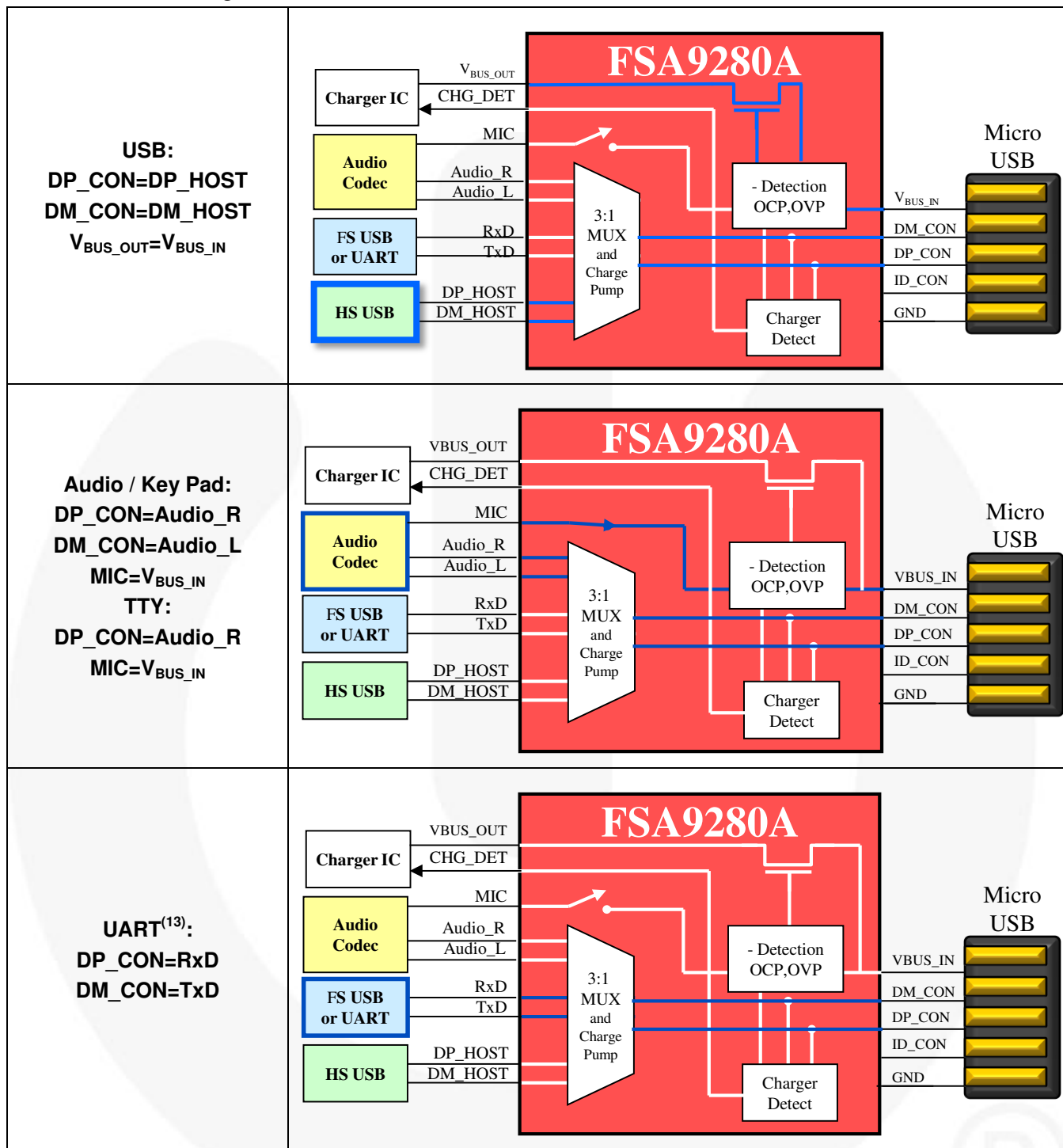


Figure 18. INT Mask to INTB Interrupt Timing Diagram

7. Switch Configuration

FSA9280A devices have two modes of operation when configuring the internal switches. The FSA9280A can auto-configure the switches or the switches can be configured manually by the processor. Typical applications can use the Auto-Configuration Mode and do not require interaction with the baseband to configure the switches correctly.

Table 5. Auto-Configurations



Note:

13. Use of FS USB on the UART path requires manual switching, as described in *Section 11.4 — Systems with Multiple USB Controllers*.

7.1. Manual Switching

Manual switching is enabled by writing the following registers:

- Manual Switch 1 (13h): Configures the switches for DM_CON, DP_CON, and V_{BUS_IN}.
- Manual Switch 2 (14h): Configures the CHG_DET, BOOT, and JIG pins.

8. Active Signal Performance

8.1. USB Data

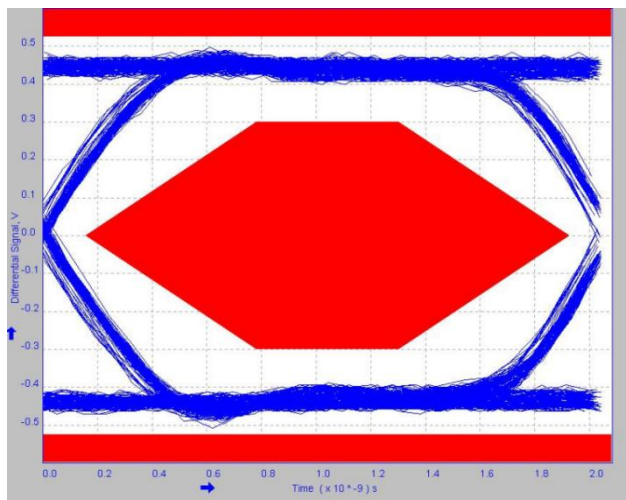


Figure 19. Pass Through Eye Compliance Testing Input Signal

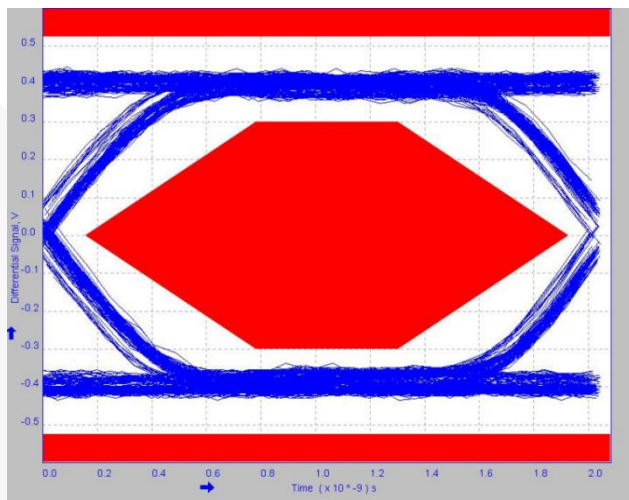


Figure 20. USB 2.0 Eye Compliance Test Results at Output

8.2. FS USB

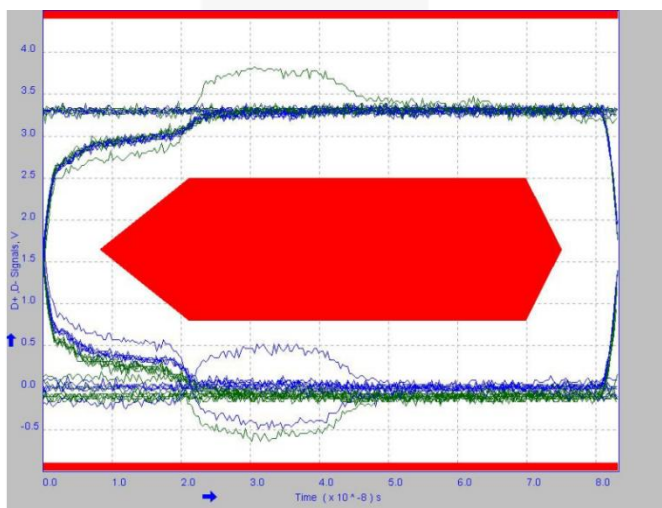


Figure 21. FS USB Eye Compliance for UART Path

8.3. Audio

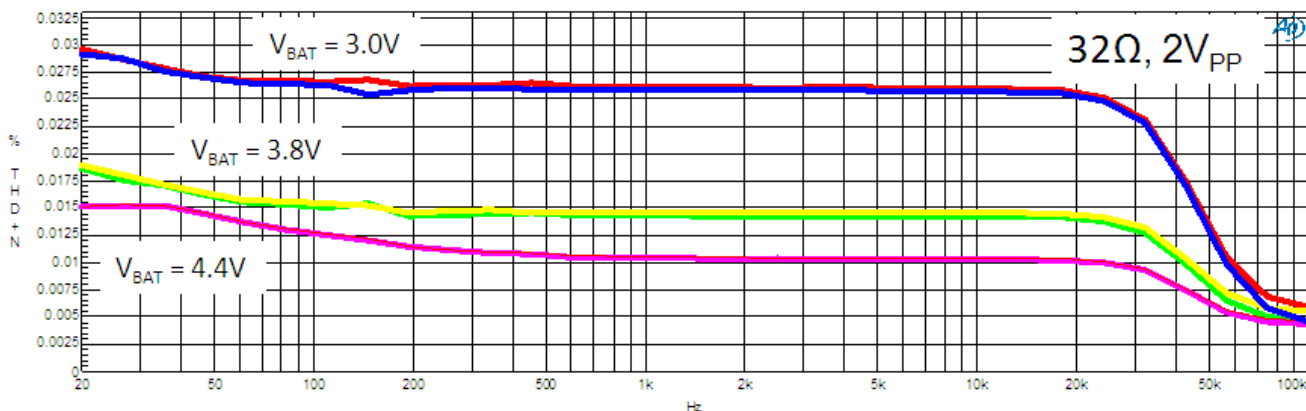


Figure 22. THD+N Plot for Audio Channels

9. Electrical Specifications

9.1. Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter		Min.	Max.	Unit
V_{BAT}/V_{DDIO}	Supply Voltage from Battery / Baseband		-0.5	6.0	V
V_{BUS_IN}	Supply Voltage from Micro-USB Connector		-0.5	28.0	V
V_{SW}	Switch I/O Voltage	USB	-1.0	$V_{BUS}+0.5$	V
		Stereo / Mono Audio Path Active	-1.5	$V_{BAT}+0.5$	
		All Other Channels	-0.5	$V_{BAT}+0.5$	
I_{IK}	Input Clamp Diode Current		-50		mA
I_{CHG}	Charger Detect CHG_DET Pin Current Sink Capability			30	mA
I_{SW}	Switch I/O Current (Continuous)	USB		50	mA
		Audio		60	
		All Other Channels		50	
I_{SWPEAK}	Peak Switch Current (Pulsed at 1ms Duration, <10% Duty Cycle)	USB		150	mA
		Audio		150	
		Charger FET		2	A
		All Other Channels		150	mA
T_{STG}	Storage Temperature Range		-65	+150	°C
T_J	Maximum Junction Temperature			+150	°C
T_L	Lead Temperature (Soldering, 10 Seconds)			+260	°C
ESD	IEC 61000-4-2 System ESD	USB Connector Pins (DP_CON, DM_CON, V_{BUS_IN} , ID_CON) to GND	Air Gap	15.0	kV
			Contact	8.0	
	Human Body Model, JEDEC JESD22-A114	JIG, BOOT, INTB		3.5	
		All Other Pins, Including DP_CON, DM_CON, ID_CON and V_{BUS_IN}		5.0	
	Charged Device Model, JEDEC JESD22-C101	All Pins	2.0		

9.2. Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to Absolute Maximum Ratings.

Symbol	Parameter		Min.	Max.	Unit
V_{BAT}	Battery Supply Voltage ⁽¹⁴⁾		3.0	4.4	V
V_{BUSIN}	Supply Voltage from V_{BUS_IN} Pin ⁽¹⁵⁾		4.0	5.5	V
V_{DDIO}	Processor Supply Voltage		1.8	3.6	V
V_{SW}	Switch I/O Voltage	USB Path Active	0	3.6	V
		Audio Path Active	-1.2	1.2	
		All Other Pins	0	5.0	
ID_{CAP}	Capacitive Load on ID_CON Pin for Reliable Accessory Detection			1.0	nF
T_A	Operating Temperature		-40	+85	°C

Note:

14. Fairchild does not guarantee operation below 3.0V.

15. Between 5.5 to OVP starting voltage, the charger FET is still closed so that charger IC can charge battery even with 5.9~6.0V travel adaptor.

9.3. Switch Path DC Electrical Characteristics

All typical values are at $T_A=25^\circ\text{C}$ unless otherwise specified.

Symbol	Parameter	V_{BAT} (V)	Conditions	$T_A = -40$ to $+85^\circ\text{C}$			Unit
				Min.	Typ.	Max.	
Host Interface Pins (JIG, BOOT, INTB, CHG-DET)							
V_{OH}	Output High Voltage ⁽¹⁶⁾	3.0 to 4.4	$I_{OH}=2\text{mA}$	$0.7 \times V_{DDIO}$			V
V_{OL}	Output Low Voltage	3.0 to 4.4	$I_{OL}=10\text{mA}$			0.4	V
Switch OFF Characteristics							
I_{OFF}	Power-Off Leakage Current	0	All Data Ports Except MIC $V_{SW}=0\text{V}$ to 4.4V			10	μA
I_{NO}	Switch Open Leakage Current with Device Powered	3.0 to 4.4	$V_{BAT}=4.4\text{V}$; I/O Pins= 0.3V , 4.1V , or Floating, Except MIC	-0.100	0.001	0.100	μA
I_{DSHRT}	Short-Circuit Current ⁽¹⁷⁾	3.0 to 4.4	Current Limit if $ID_CON=0\text{V}$		5		mA
USB Switch ON Path							
USB Analog Signal Range		3.0 to 4.4		0		3.6	V
R_{ONUSB}	USB Switch On Resistance ⁽¹⁸⁾	3.0 to 4.4	$V_{D+/D-}=0\text{V}$, 0.4V , $I_{ON}=8\text{mA}$		8	10	Ω
Charging FET ON Path							
V_{OVP}	Over-Voltage Protection (OVP) Threshold Voltage			6.2	6.8	7.2	V
R_{ONFET}	Charging FET On Resistance ⁽¹⁷⁾		$V_{BUS_IN}=4.2\text{V}-5.0\text{V}$, $I_{ON}=1\text{A}$		200		$\text{m}\Omega$
I_{OCP}	Over-Current Protection (OCP) Threshold Current ⁽¹⁷⁾		$V_{BUS_IN}=5.2\text{V}$	1.1	1.3	1.5	A
Audio_R/Audio_L Switch ON Paths							
Audio Analog Signal Range		3.0 to 4.4		-1.2		3.0	V
R_{ON}	Audio Switch On Resistance ⁽¹⁸⁾	3.0 to 4.4	$V_{L/R}=-0.8\text{V}$, 0.8V , $I_{ON}=30\text{mA}$, $f=0-470\text{kHz}$			3	Ω
R_{FLAT}	Audio R_{ON} Flatness ⁽¹⁹⁾	3.0 to 4.4				0.1	Ω
MIC and UART Switch ON Paths							
Analog Signal Range ⁽²⁰⁾		3.0 to 4.4		0		5	V
R_{ON}	MIC Path ON Resistance	3.0 to 4.4	$V_{SW}=0\text{V}$, 4.4V , $I_{ON}=30\text{mA}$		40		Ω
	UART Path ON Resistance ⁽¹⁷⁾				25	30	
Total Current Consumption							
I_{CCSL}	Battery Supply Standby Mode Current (No Accessory Attached)	3.0 to 4.4	No Accessory Static Current During Standby Mode		10	25	μA
I_{CCSLWA}	Battery Supply Standby Mode Current with Accessory Attached ⁽²¹⁾	3.8	With Accessory Static Current During Standby Mode		30	40	μA

Notes:

16. Does not apply to CHG_DET or JIG pins because they are open drain.
17. Limits based on electrical characterization data.
18. On resistance is the voltage drop between the two terminals at the indicated current through the switch.
19. Flatness is defined as the difference between the maximum and minimum values of on resistance over the specified range of conditions.
20. The MIC bias applied by the baseband should not exceed 2.8V .
21. Applies to all accessories except Audio Type 1 and Factory-Mode accessories.

9.4. Capacitance

Symbol	Parameter	V _{BAT} (V)	Condition	T _A = -40 to +85°C			Unit
				Min.	Typ.	Max.	
C _{ONUSB}	DP_CON, DM_CON On Capacitance (USB Mode)	3.8	V _{BIAS} =0.2V, f=1MHz		8		pF

9.5. Switch Path AC Electrical Characteristics

All typical values are for V_{BAT}=3.8V at T_A=25°C unless otherwise specified.

Symbol	Parameter		Condition	T _A = -40 to +85°C			Unit
				Min.	Typ.	Max.	
Xtalk	Active Channel Crosstalk DP_CON to DM_CON	Audio Mode	f=20kHz, R _T =32Ω, C _L =0pF		-50		dB
		USB Mode	f=1MHz, R _T =50Ω, C _L =0pF		-60		
			f=240MHz, R _T =50Ω, C _L =0pF		-40		
O _{IRR}	Off Isolation	Audio Mode	f=20kHz, R _T =32Ω, C _L =0pF		-90		dB
		USB Mode	f=1 MHz, R _T =50Ω, C _L =0pF		-90		
PSRR	Power Supply Rejection Ratio, MIC on V _{BUS_IN}		Power Supply Noise 300mV _{pp} , f=217Hz		-100		dB
THD	Total Harmonic Distortion (Audio Path)		20Hz to 20kHz, R _L =32/16Ω, Input Signal Range 2V _{PP}		0.03		%
			20Hz to 20kHz, R _L =32/16Ω, Input Signal Range -1.2V to 1.2V		0.05		
t _{SK(P)}	Skew of Opposite Transitions of the Same Output (USB Mode)		t _r =t _f =750ps (10-90%) at 240MHz, C _L =0pF, R _L =50Ω		30		ps
t _{I2CRST}	Time When I2C_SDA and I2C_SCL Both LOW to Cause a Reset		See Figure 6	30			ms
t _{INTMASK}	Time after INT Mask Cleared to "0" until INTB Goes LOW to Signal the Interrupt after Interruptible Event while INT Mask Bit Set to "1"		See Figure 18		10		ms
t _{SDPDET}	Time from V _{BUS_IN} Valid to V _{BUS_OUT} Valid with Charger FET Closed and USB Switches Closed for USB Standard Downstream Port		See Figure 10		130		ms
t _{CHGOUT}	Time from V _{BUS_IN} Valid to V _{BUS_OUT} Valid with the Charger FET Closed for Both USB Charging Ports (CDP and DCP)		See Figure 9		170		ms
t _{CARKIT}	Time from V _{BUS_IN} Valid to Car Kit Type 1 or Type 2 Charger Detected		See Figure 11		200		ms
t _{CHGDET}	Time from V _{BUS_OUT} Valid to CHG_DET Output LOW for Both USB Charging Ports (CDP and DCP) and for Car Kit Chargers		See Figure 9, Figure 11		100		ms
t _{IDDET}	Time from ID_CON Not Floating to INTB LOW to Signal Accessory Attached that is ID_CON Resistance-Based Only (V _{BUS_IN} Not Valid)		See Figure 8		200		ms
t _{JIGVBUS}	Time from V _{BUS_IN} Valid to JIG LOW and V _{BUS_OUT} Valid with Charger FET Closed for Both Factory Mode Operation with V _{BUS_IN} Present		See Figure 25		200		ms
	Time from V _{BUS_IN} Valid to JIG LOW for Factory Mode Operation without V _{BUS_IN} Present		See Figure 26		200		ms

9.6. I²C Controller DC Characteristics

Symbol	Parameter	Fast Mode (400kHz)		
		Min.	Max.	Units
V _{IL}	Low-Level Input Voltage	-0.5	0.3V _{DDIO}	V
V _{IH}	High-Level Input Voltage	0.7V _{DDIO}		V
V _{HYS}	Hysteresis of Schmitt Trigger Inputs	V _{DDIO} >2V	0.05V _{DDIO}	V
		V _{DDIO} <2V	0.1V _{DDIO}	
V _{OL1}	Low-Level Output Voltage at 3mA Sink Current (Open-Drain)	V _{DDIO} >2V	0	V
		V _{DDIO} <2V	0.2V _{DDIO}	
I _{I2C}	Input Current of I2C_SDA and I2C_SCL Pins, Input Voltage 0.26V to 2.34V	-10	10	μA
C _I	Capacitance for Each I/O Pin		10	pF

9.7. I²C AC Electrical Characteristics & Register Map

Symbol	Parameter	Fast Mode		
		Min.	Max.	Unit
f _{SCL}	SCL Clock Frequency	0	400	kHz
t _{HD;STA}	Hold Time (Repeated) START Condition	0.6		μs
t _{LOW}	LOW Period of SCL Clock	1.3		μs
t _{HIGH}	HIGH Period of SCL Clock	0.6		μs
t _{SU;STA}	Set-up Time for Repeated START Condition	0.6		μs
t _{HD;DAT}	Data Hold Time	0	0.9	μs
t _{SU;DAT}	Data Set-up Time ⁽²²⁾	100		ns
t _r	Rise Time of SDA and SCL Signals ⁽²³⁾	20+0.1C _b	300	ns
t _f	Fall Time of SDA and SCL Signals ⁽²³⁾	20+0.1C _b	300	ns
t _{SU;STO}	Set-up Time for STOP Condition	0.6		μs
t _{BUF}	BUS-Free Time between STOP and START Conditions	1.3		μs
t _{SP}	Pulse Width of Spikes that Must Be Suppressed by the Input Filter	0	50	ns

Notes:

22. A fast-mode I²C-Bus® device can be used in a standard-mode I²C-Bus system, but the requirement t_{SU;DAT} ≥ □250ns must be met. This is automatically the case if the device does not stretch the LOW period of the SCL signal. If such a device does stretch the LOW period of the SCL signal, it must output the next data bit to the SDA line t_{r,max} + t_{SU;DAT} = 1000 + 250 = 1250ns (according to the standard-mode I²C bus specification) before the SCL line is released.
23. C_b equals the total capacitance of one BUS line in pF. If mixed with high-speed devices, faster fall times are allowed according to the I²C specification.

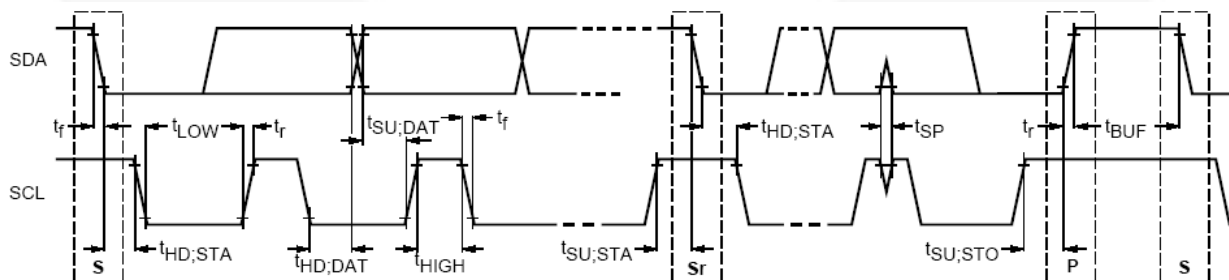


Figure 23. Definition of Timing for Full-Speed Mode Devices on the I²C Bus

Table 6. I²C Slave Address

Name	Size (Bits)	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Slave Address	8	0	1	0	0	1	0	1	R/W

Table 7. Register Map

Address	Register	Type	Reset Value	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
01H	Device ID	Read	00000000	Version ID: 0xb001					Vendor ID (Fairchild): 000			
02H	Control	Read / Write	00011111	Reserved: - Read XXX - Write 000			Switch Open	ADC Interrupt Disable	Manual Switch	Configuration Delay	Global Interrupt Mask	
							0: Open All switches	0: Report interrupt when detection is complete on ID_CON	0: Automatic configuration disabled, switch configuration based on Manual Switch registers (13H, 14H)	0: After wait time expires delay configuration indefinitely until this bit is written to 1 by host	0: Does not Mask Interrupts	
							1: Switch based on detection	1: ADC change interrupt is disabled	1: Automatic configuration is enabled	1: If wait time has expired configure the switches immediately (See figure 2(flow chart))	1: Mask interrupts	
03H	Interrupt 1	Read / Clear	00000000	OVP & OCP Recovery	OCP Event	OVP Event	Long Key Release	Long Key Press	Key Press	Detach	Attach	
				0: OVP and/or OCP event not recovered		0: No OCP event	0: No OVP event	0: No Interrupt				
				1: OVP and/or OCP event recovered		1: OCP event	1: OVP event	1: Long key release detected	1: Long key press detected	1: Key press detected	1: Accessory detached	1: Accessory attached
04H	Interrupt 2	Read / Clear	00000000	Reserved: - Read XXX - Write 000			Stuck Key Recovery	Stuck Key	ADC Change	Reserved Attach		Reserved: - Read X - Write 0
							0: No Interrupt					
							1: Stuck key recovered	1: Stuck key detected	1: Valid ADC detection	1: Reserved accessory attached		
05H	Interrupt Mask 1	Read / Write	00000000	OVP & OCP	OCP	OVP	Long Key Release	Long Key Press	Key Press	Detach	Attach	
				0: No Interrupt Mask								
				1: Mask – Interrupt 1 [OVP & OCP Recovery]	1: Mask – Interrupt 1 [OCP Event]	1: Mask – Interrupt 1 [OVP Event]	1: Mask – Interrupt 1 [Long Key Release]	1: Mask – Interrupt 1 [Long Key Press]	1: Mask – Interrupt 1 [Key Press]	1: Mask – Interrupt 1 [Detach]	1: Mask – Interrupt 1 [Attach]	
06H	Interrupt Mask 2	Read / Write	00000000	Reserved: - Read XXX - Write 000			Stuck Key Recovery	Stuck Key	ADC Change	Reserved Attach		Reserved: - Read X - Write 0
							0: No Interrupt Mask					
							1: Mask – Interrupt 2 [Stuck Key Recovery]	1: Mask – Interrupt 2 [Stuck Key]	1: Mask – Interrupt 2 [ADC Change]	1: Mask – Interrupt 2 [Reserved Attach]		
07H	ADC	Read	00011111	Reserved: - Read XXX, - Write 000				ADC Value (See Table 8)				
08H	Timing Set 1	Read / Write	00000000	Key Press Time (See Table 8)				ADC Detection Time (See Table 8)				
09H	Timing Set 2	Read / Write	00000000	Switching Wait Time (See Table 8)				Long Key Press Time (See Table 8)				

Continued on the following page...

Address	Register	Type	Reset Value	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
0AH	Device Type 1	Read	00000000	Reserved: - Read X - Write 0	USB Charging (DCP)	USB Charging (CDP)	Car Kit Charger	UART	USB Data (SDP)	Reserved: - Read X - Write 0	Audio Type 1	
					0: No detect						1: USB standard downstream port (SDP) detected	1: Audio Type 1 accessory detected
					1: USB dedicated charging port (DCP) detected	1: USB charging downstream port (CDP) detected	1: Car Kit charger detected	1: UART detected				
0BH	Device Type 2	Read	00000000	Reserved: - Read XX - Write 00	TTY		Reserved: - Read X - Write 0	Factory Mode – See Table 9				
					0: No detect			0: No detect				
					1: TTY detected			1: Jig: UART – Boot_OFF	1: Jig: UART – Boot_ON	1: Jig: USB – Boot_OFF	1: Jig: USB – Boot_ON	
0CH	Button 1	Read	00000000	Button 7	Button 6	Button 5	Button 4	Button 3	Button 2	Button 1	Send End	
				0: Not Pressed								1: Pressed
0DH	Button 2	Read	00000000	Reserved: - Read XX - Write 00	Key Press Error	Button 12	Button 11	Button 10	Button 9	Button 8		
					0: No Key Press Error	0: Not Pressed						
					1: Key Press Error detected (too short)	1: Pressed						
0EH	Car Kit Status	Read	00000000	Reserved: - Read XXXXXX - Write 000000						Charger Type		
										00: No connection 01: Reserved Charger 10: Car Kit charger type 1 11: Car Kit charger type 2		
0FH	Reserved	N/A	00000000	Reserved: - Read XXXXXXXX, - Write 00000000								
10H	Reserved	N/A	00000000	Reserved: - Read XXXXXXXX, - Write 00000000								
11H	Reserved	N/A	00000000	Reserved: - Read XXXXXXXX, - Write 00000000								
12H	Reserved	N/A	00000000	Reserved: - Read XXXXXXXX, - Write 00000000								
13H	Manual Switch 1	Read / Write	00000000	DM_CON Connection			DP_CON Connection			V _{BUS} Connection		
				000: Open DM_CON switch 001: DM_CON connected to DM_HOST of USB port 010: DM_CON connected to Audio_L 011: DM_CON connected to TxD of UART port			000: Open DP_CON switch 001: DP_CON connected to DP_HOST of USB port 010: DP_CON connected to Audio_R 011: DP_CON connected to RxD of UART port			00: Open VBUS switch 01: VBUS_OUT connected to VBUS_IN (Host – current sourced from the phone to accessory, max. load current is 5mA) 10: VBUS_IN connected to MIC 11: VBUS_IN connected to VBUS_OUT (Standard USB – phone sinks current from attached accessory)		
14H	Manual Switch 2	Read / Write	00000000	Reserved: - Read XXX - Write 000	CHG_DET	BOOT	JIG	Reserved: - Read XXX - Write 000				
					0: High Impedance	0: Low	0: High Impedance					
					1: Low	1: High	1: Low					

Continued on the following page...

Address	Register	Type	Reset Value	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
15H	Reserved	N/A	00000000	Reserved: - Read XXXXXXXX, - Write 00000000							
16H	Reserved	N/A	XXXXXXX0	Reserved: - Read XXXXXXXX, - Write 00000000							
17H	Reserved	N/A	00000000	Reserved: - Read XXXXXXXX, - Write 00000000							
18H	Reserved	N/A	00000000	Reserved: - Read XXXXXXXX, - Write 00000000							
19H	Reserved	N/A	00000000	Reserved: - Read XXXXXXXX, - Write 00000000							
1AH	Reserved	N/A	00000000	Reserved: - Read XXXXXXXX, - Write 00000000							
1BH	Reset	R/W	X0001000	Reserved: - Read XXXXXXXX, - Write 0000100							Reset 0: No Reset 1: Reset (Always reads 0)
1CH	Reserved	N/A	XXXXX001	Reserved: - Read XXXXXXXX, - Write 00000001							
1DH	Reserved	N/A	00000000	Reserved: - Read XXXXXXXX, - Write 00000000						V _{BUS_IN} VALID 0: V _{BUS_IN} Not Valid 1: V _{BUS_IN} Valid	Reserved: - Read X, - Write 0
1EH	Reserved	N/A	XXXXXXX X	Reserved: - Read XXXXXXXX, - Write 00000000							
1FH	Reserved	N/A	XXXXXXX X	Reserved: - Read XXXXXXXX, - Write 00000000							
20H	DCD Configuration	Read/Write	XXXXXX00	Reserved: - Read XXXXXXXX, - Write 00000000				Enable DCD Timeout 0: DCD Timeout Not Enabled 1: DCD Timeout Enabled	Reserved: Read XX, - Write 00		
21H	Reserved	N/A	XXXXXX00	Reserved: - Read XXXXXXXX, - Write 00000000							

Table 8 – Timing for Timing Set 1 & 2 Registers

Setting Value ⁽²⁴⁾	ADC Detection Time	Key Press Time	Long Key Press Time	Switching Wait Time
0000	50ms	100ms	300ms	10ms
0001	100ms	200ms	400ms	30ms
0010	150ms	300ms	500ms	50ms
0011	200ms	400ms	600ms	70ms
0100	300ms	500ms	700ms	90ms
0101	400ms	600ms	800ms	110ms
0110	500ms	700ms	900ms	130ms
0111	600ms	800ms	1000ms	150ms
1000	700ms	900ms	1100ms	170ms
1001	800ms	1000ms	1200ms	190ms
1010	900ms		1300ms	210ms
1011	1000ms		1400ms	
1100			1500ms	
1101-1111				

Note:

24. Each of the four registers can have unique register setting values.

9.8. Factory Modes

The FSA9280A has four dedicated Factory Modes that allow efficient factory testing of a platform. Factory Modes are initiated with the attachment of special test hardware, called a “JIG box” used for factory testing. FSA9280A automatically configures switch paths to any factory-mode accessories when V_{DDIO} is present, without detaching and attaching the micro-USB cable. Since the processor may not be awake when a factory-mode accessory is detected, I²C read acknowledge is not required, nor does the FSA9280A employ a switching wait timer found in the *Timing Set 2* register for the initial switch configuration. A change of resistor on the ID_CON pin dynamically switches between factory modes and auto-configures the appropriate switch paths without detaching and attaching the cable.

JIG output signals when a factory-mode accessory is plugged in and BOOT output signals the baseband processor to boot up, allowing tests to be conducted with and without the baseband processor powered up. As soon as the factory-mode cable is removed, the FSA9280A returns to a standard accessory flow that requires a device detach between accessory type configurations changes (except Audio Type 1 accessory described in the Audio Accessory Detection section above). The typical key sensing for Audio Type 1 accessories for wired remote is not active for factory-mode test.

9.8.1. Factory-Mode Accessory Detection

The different factory-mode accessories with the associated resistor values (1% standard resistors) on the ID_CON pin, the JIG and BOOT logic states, and switch configurations are listed in Table 9.

Table 9. Factory Mode Auto-Configuration Table (1% Resistors on ID_CON Pin)

Configuration Type		V_{BUS_IN}	DP_CON	DM_CON	ID_CON	BOOT	JIG	CHG_DET
Factory Mode 0 Jig: UART	Boot_On	Chg FET Open ⁽²⁵⁾	RxD	TxD	619k Ω	HIGH	LOW	Hi-Z
	Boot_Off	Chg FET Open ⁽²⁵⁾	RxD	TxD	523k Ω	LOW	LOW	Hi-Z
Factory Mode 1 Jig: USB	Boot_On	Chg FET Closed	DP_Host	DM_Host	301k Ω	HIGH	LOW	Hi-Z
	Boot_Off	Chg FET Closed	DP_Host	DM_Host	255k Ω	LOW	LOW	Hi-Z
Audio Type 1 ⁽²⁵⁾	Full Remote	⁽²⁶⁾	Audio_R	Audio_L	1000k Ω	LOW	LOW	Hi-Z
	Send/End Remote	⁽²⁶⁾	Audio_R	Audio_L	1002k Ω	LOW	LOW	Hi-Z

Notes:

- 25. The charger FET closes for factory-mode BOOT ON-UART or factory-mode BOOT OFF-UART if VBUS_IN is valid only during the time when the cable is first plugged in or a new ID_CON resistor is detected.
- 26. Audio-type device configuration is entered as part of the factory-mode flow shown in Figure 24 where the ID_CON pin is not monitored for key presses and JIG remains LOW until the factory jig box is detached from the phone. MIC is not connected in this audio type case. Figure 24 provides the attach flow diagram for the JIG box accessory. If any of the factory modes is first entered and JIG=LOW; then and only then, can the ID_CON resistor (1M Ω) dynamically switch to Audio Type 1 accessory without a cable detach. For the latter case, factory-mode Audio Type 1 accessory auto-configures the switches such that: Audio_L = DM_CON.
- 27. MIC is left unconnected.
- 28. The typical key sensing for Audio Type 1 accessories for wired remote is not active for this factory-mode test.

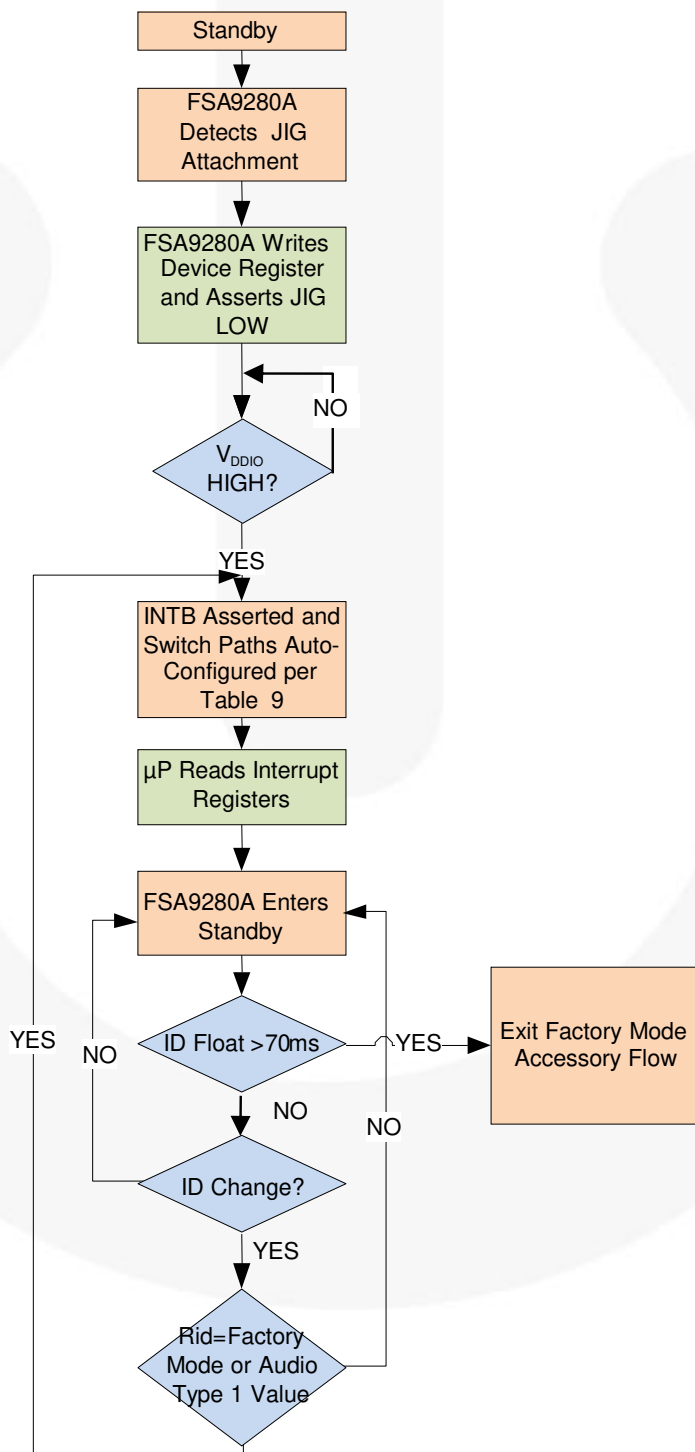


Figure 24. Factory Mode Flow