Application Report
SWRA134–March 2007

BRF6300/6350 SDIO Host-Controller Interface

Bluetooth Applications Group

ABSTRACT

This document describes the BRF6300/6350 SDIO Host-Controller interface. Specifically, it discusses the supported features of the interface, and the sleep/wake-up protocol for the SDIO Host and the BRF6300/6350 devices. It also reviews the configuration of the shared SDIO bus mode.

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1 Overview

The BRF6300/6350 (BRF63xx) provide a secure digital input/output (SDIO) interface as an additional transport layer to the Universal Asynchronous Receiver Transmitter (UART). The interface is based on and compatible with all aspects of SD memory card technology, including mechanical, electrical, power, signaling, and software. The SDIO card provides high-speed data I/O with low power consumption for mobile electronic devices.

The term ***BRF63xx*** refers to both the BRF6300 and the BRF6350 devices, unless otherwise specified.

Note: Reader familiarity with the SDIO card specification v1.00 and with the Type-A Specification for Bluetooth® v1.00 is strongly advised.

2 Supported Features

- SDIO Specification 1.0 compliance:
  - SDIO 1-bit SD mode
  - SDIO mandatory commands and functions
  - SDIO Card Type-A for Bluetooth compliant
- Only 1.8V IO voltage
- Up to 25MHz external clock rate for the BRF6350
- Up to 20MHz external clock rate for the BRF6300
- Number of functions supported: One
- Interrupt to host supported (for all modes)
- Maximum number of data bytes transferred in one transaction: 128 bytes
- Abort supported only for CMD53 Read transactions
- Read Wait ***not*** supported
- Suspend and resume ***not*** supported
- Block Basis mode ***not*** supported
- Multi-block data transfer ***not*** supported
- Infinite data transfer ***not*** supported
- Data transfer to Function 1 via CMD53 only
- Shared SDIO bus mode

2.1 Supported Bluetooth Protocol Layers in the SDIO Card Type-A for Bluetooth

Figure 1 depicts the supported Bluetooth protocol layer in the SDIO Card Type-A for Bluetooth (BT). The radio, baseband, link management protocol (LMP) and hardware control interface (HCI) reside in the card.

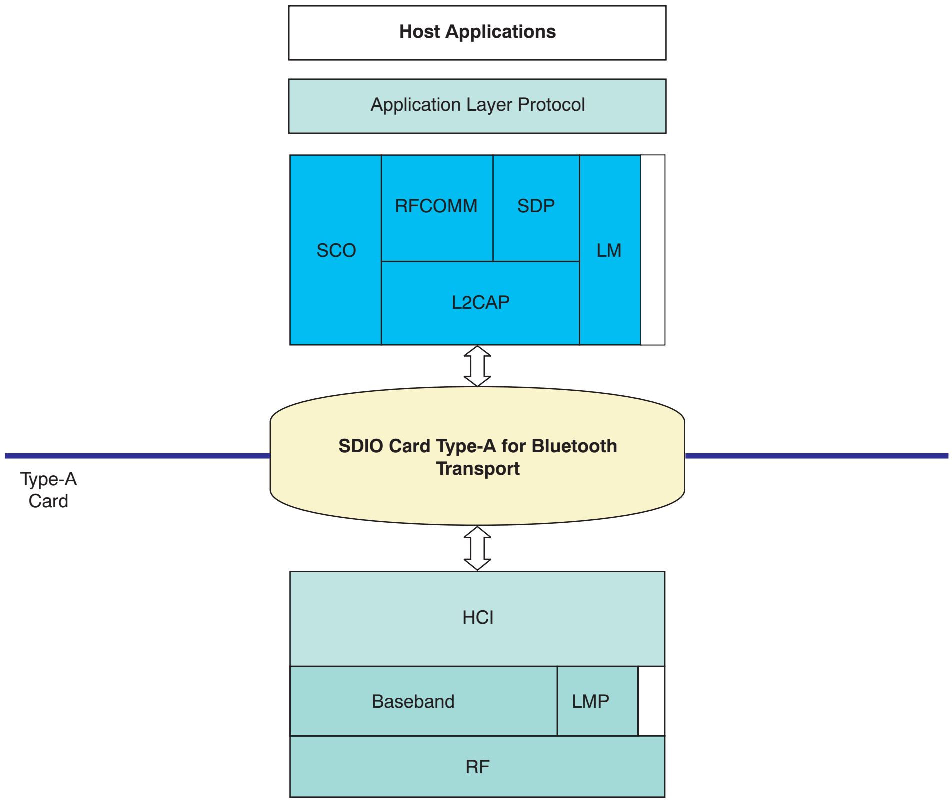

Figure 1. Typical Application in Data Communications (from the Type-A Specification for Bluetooth, v1.00)

3 SDIO Interface Description

Figure 2 illustrates the SDIO interface signals for the BRF63xx. Table 1 describes the signals.

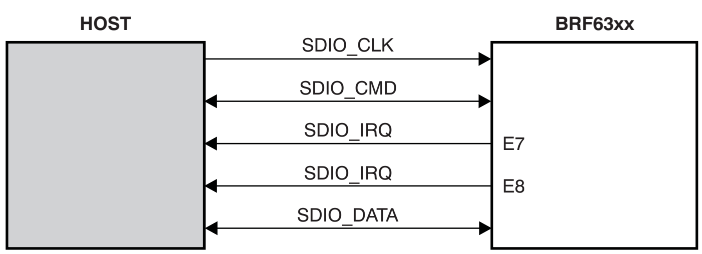

Figure 2. SDIO Interface Signals

Table 1. SDIO Interface Signals

Port Name	In/Out	Description
SDIO_CLK	I	SDIO interface clock (0MHz to 25MHz)
SDIO_CMD	I/O	CMD line in SDIO, D_{IN} in SPI mode (single pins with different nomenclatures for SDIO modes, respectively)
SDI_IRQ	O	IRQ
SDI_DATA	I/O	Data line

SDIO_IRQ is output on both E7 and E8 pins. This architecture provides the following options to the host:

- **Use E7 only**: Use E7 to provide both the chip-initialization-complete signal and the IRQ signal. E7 first goes low as chip-initialization-complete signal. Thereafter, E7 functions as SDIO_IRQ. Note that in this scheme, SDIO_IRQ is low initially, even though the BRF63xx may not want to interrupt the host.
- **Use both E7 and E8:** In this case, E8 may be used as a dedicated SDIO_IRQ signal. E7 is used as the chip-initialization-complete signal as just described. Note, however, that E7 does not remain low, but also toggles as an SDIO_IRQ signal .

Both E7 and E8 are set high after the chip powers on. Only E7 goes low to indicate that chip initialization is complete.

3.1 Initialization

After reset or power-up, all I/O functions are disabled; the SDIO does not respond to any commands from the host except for CMD5. All SDIO transactions occur with respect to the positive edge of the SDIO clock.

The initialization sequence (shown in Figure 3) follows the description given in the SDIO Card Specification v1.00 and that given in the Type-A Specification for Bluetooth v1.00.

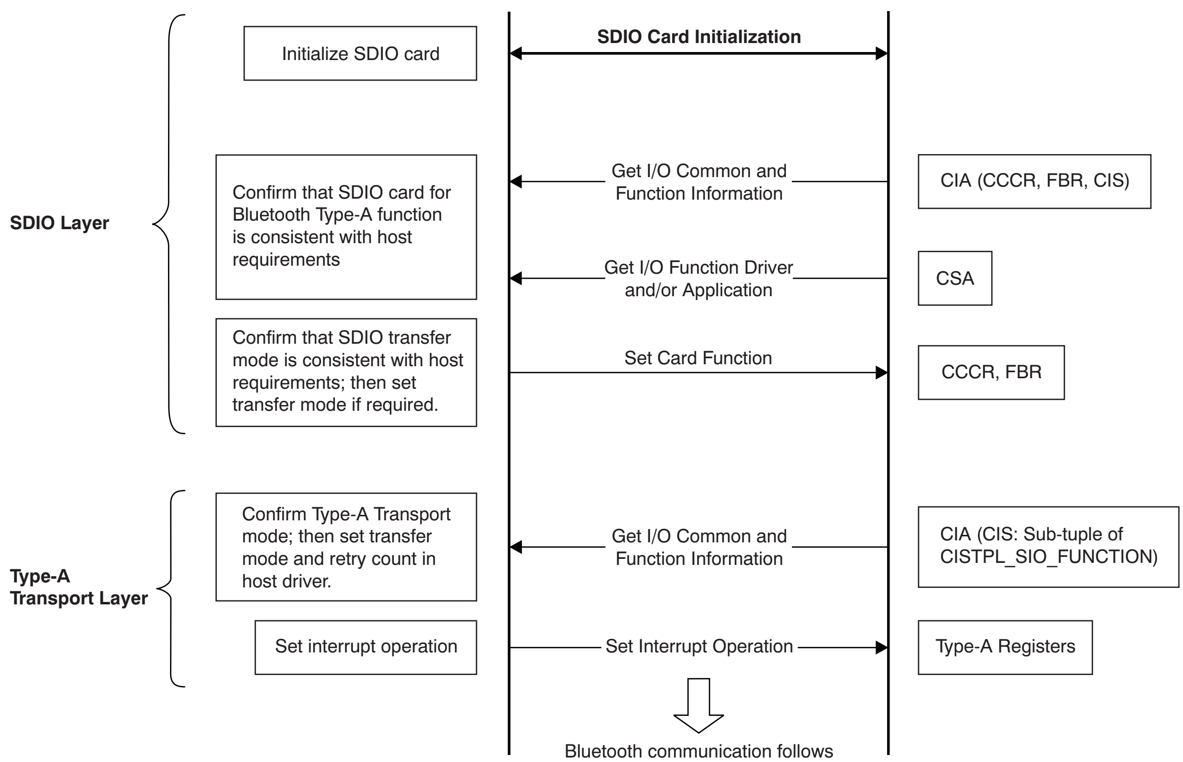

Figure 3. Example of SDIO Card Type-A Initialization Procedure for Bluetooth

3.2 Type-A Header Issue

There may be a problem in the header interpretation by the BRF63xx V1.11/V1.21. On Microsoft Windows® CE (WinCE) platforms, we have experienced the following problem:

> Type A header is four bytes long, composed of three bytes for packet length and one byte for the Service ID.

The BRF63xx expects to receive the entire header LSB first, meaning that the Service ID is first followed by the Packet Length. However, the WinCE host sends Packet Length first and then the Service ID. For example, say that the four header bytes are: `0071` (packet length is 7 and Service ID is 1). The BRF63xx expects to receive the complete header, `1700`, but the host sends the packet length and then the service ID, or `7001`.

There is a relatively easy fix for the SDIO Host driver that is available. Refer to Appendix B: *Code Example—Fixing the Type-A Header Issue* for a code example.

4 Deep-Sleep Protocol

4.1 General Description

In order to maintain synchronization between the host and the BRF63xx, it is important for each side to know when the other is going into low-power mode. However, the SDIO v1.00 specification does not explicitly define a low-power mode protocol between a host and a device.

This section describes how the SDIO Host and the BRF63xx device inform each other of the respective device power modes.

4.2 Deep-Sleep Protocol Registers

The SDIO deep-sleep protocol uses a master-slave configuration. The master initiates all transactions; it is therefore the responsibility of the master to take the device into and out of low-power mode.

Table 2 shows the register map for the Type-A Specification for Bluetooth. Two new registers (see Table 3) dedicated to the SDIO deep-sleep protocol are defined here, in addition to those listed in Table 2. The existing registers in the BT register map (defined by the Type-A Specification for Bluetooth) were not modified.

Table 2. SDIO Card Type-A for Bluetooth Register Map

Address	R/W	Register Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x00	Read-only	Receiver Data	RDAT							
	Write-only	Transmitter Data	TDAT							
0x10	Write-only	Read Packet Control	0	0	0	0	0	0	0	PC RRT
0x11	Write-only	Write Packet Control	0	0	0	0	0	0	0	PC WRT
0x12	Read-only	Retry Control Status	0	0	0	0	0	0	0	RTC STAT
	Write-only	Retry Control Set	0	0	0	0	0	0	0	RTC SET
0x13	Read-only	Interrupt Identification	0	0	0	0	0	0	0	INTRD
	Write-only	Interrupt Clear	0	0	0	0	0	0	0	CL INTRD
0x14	Read/Write	Interrupt Enable	0	0	0	0	0	0	0	EN INTRD
0x20	Read-only	Bluetooth Mode Status	0	0	0	0	0	0	0	MD STAT

The first register, ***Bluetooth Sleep Command***, is used by the host for two purposes: the host wakes up the BRF63xx device using this register, and also indicates to the BRF63xx that it is allowed to enter low-power mode.

The second register, ***Bluetooth Sleep State***, is used by the host to read the device power mode. By reading this register, the host can confirm whether or not the BRF63xx device is in deep-sleep mode.

Table 3 describes the two registers.

Table 3. SDIO Deep-Sleep Protocol Registers

Address	R/W	Register Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x40	Write-only	Bluetooth Sleep Command	0	0	0	0	0	0	0	SLP CMD
0x42	Write-only	Bluetooth Sleep State	0	0	0	0	0	0	0	SLP STAT

4.3 Entering Deep-Sleep Mode

The BRF63xx can enter deep-sleep mode (low-power mode) only if the host allows it to do so. The host issues CMD52 to write '1' to address 0x40—asserting the SLP_CMD bit in the Bluetooth Sleep Command register. Table 4 shows the required command format.

Table 4. Command CMD52 Format—SDIO Host Initiates Deep Sleep

S	D	Command Index	R/W Flag	Function Number	RAW Flag	Stuff	Register Address	Stuff	Write Data or Stuff Bits	CRC	E
0	1	110100b	1	001b	0		0x40		0x1		1

When the BRF63xx is in sleep mode, it polls the SLP_CMD bit in the **Bluetooth Sleep Command** register. Only after this bit is asserted can the BRF63xx enter deep-sleep mode.

Upon entering deep-sleep mode, the BRF63xx asserts the SLP_STAT bit of the **Bluetooth Sleep State** register; that is, it writes '1' to the bit. Figure 4 shows the process of entering deep-sleep mode.

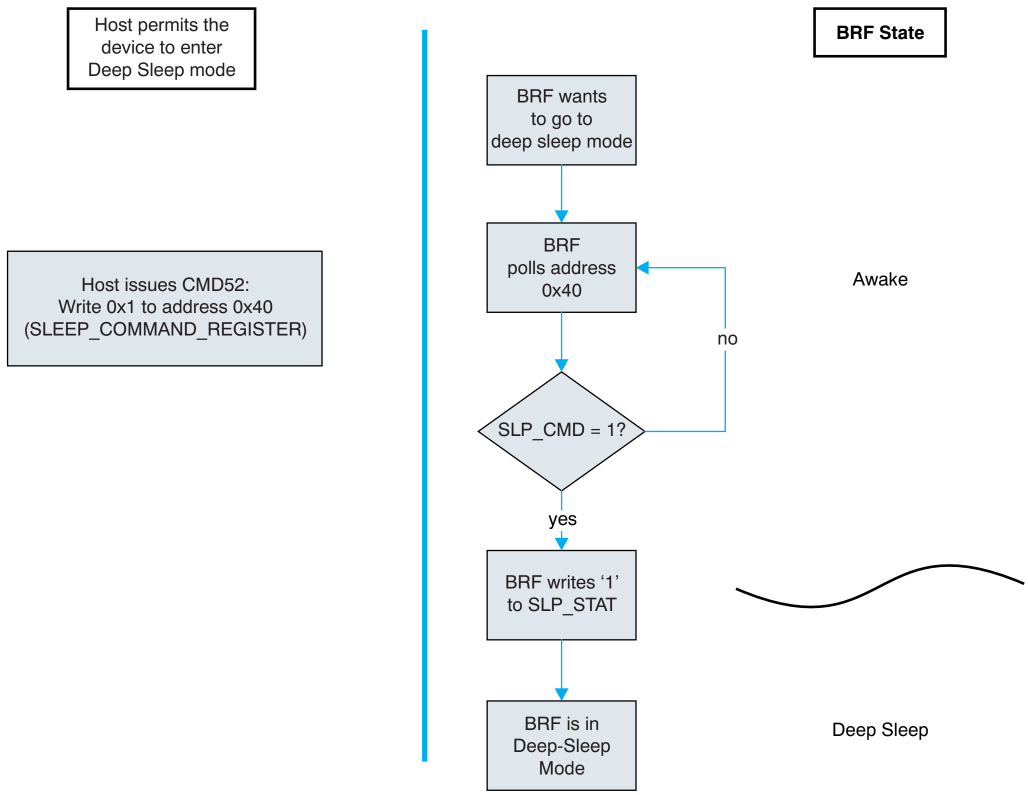

Figure 4. BRF63xx Device Enters Deep-Sleep Mode

4.4 Exiting Deep-Sleep Mode

4.4.1 Host Initiates Wake-Up

The SDIO Host wakes up the BRF63xx by issuing CMD52, writing '0' to address 0x40 and de-asserting the SLP_CMD bit in the Bluetooth Sleep Command register. Table 5 shows the required command format.

Table 5. Command CMD52 Format—SDIO Host Initiates Wake-Up

S	D	Command Index	R/W Flag	Function Number	RAW Flag	Stuff	Register Address	Stuff	Write Data or Stuff Bits	CRC	E
0	1	110100b	1	001b	0		0x40		0x0		1

Upon wake up, the BRF63xx writes '0' to the SLP_STAT bit of the Bluetooth Sleep State register. (There is a hardware mechanism incorporated within the BRF63xx that enables the SDIO Host to write to the device registers even when the device is in deep-sleep mode.)

Figure 5 illustrates the process of the host waking up the device.

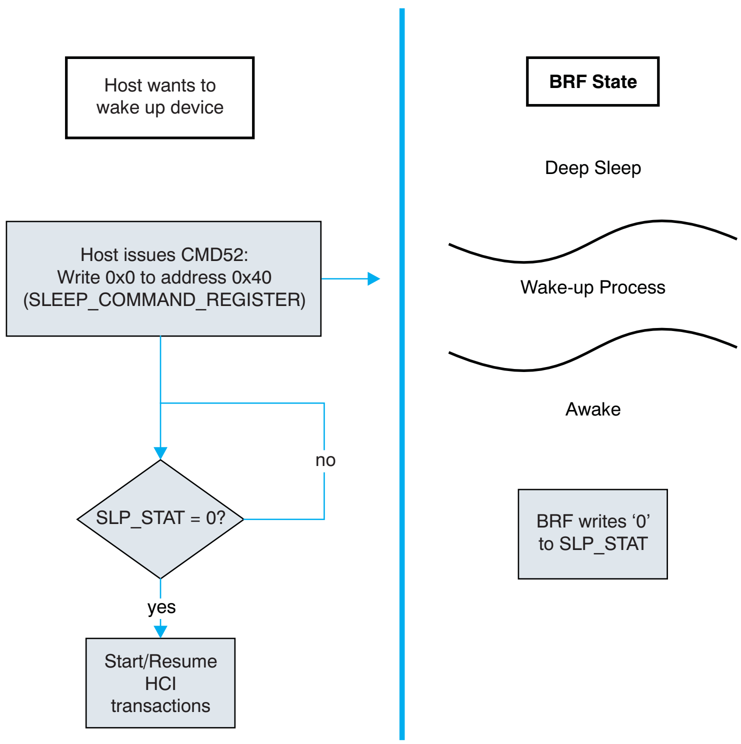

Figure 5. Host Wakes Up Device

4.4.2 Device Initiates Wake-Up

Whenever the device want to exit the low-power mode (that is, it has an event to send), it asserts the interrupt line (IRQ). The host must then write '0' to the SLP_CMD bit in the Bluetooth Sleep Command register. Polling the SLP_STAT bit is not required in this scenario.

Figure 6 shows the wake-up process.

Note: This behavior presumes that the BRF63xx device can signal the host of a wake-up event asynchronously (even when the SD clock is not supplied to the BRF63xx).

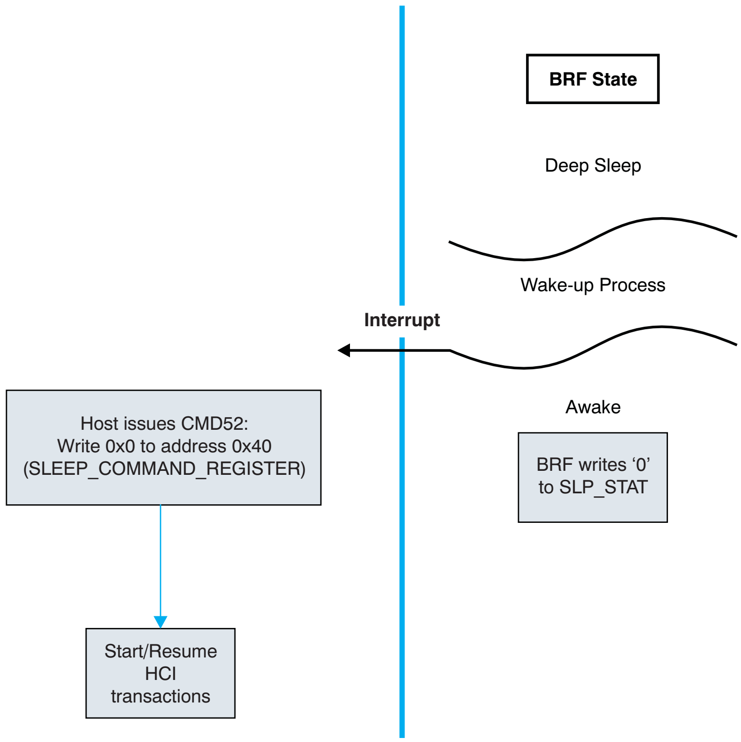

Figure 6. Device Initiates Wake-Up

4.5 *BRF63xx Power Mode Status*

The SDIO Host may inquire about the power mode of the BRF63xx device by reading the SLP_STAT bit of the Bluetooth Sleep State register. The host issues CMD52 and reads from address 0x42. Table 6 shows the required command format.

Table 6. Command CMD52 Format—Host Reads Power-Mode Status

S	D	Command Index	R/W Flag	Function Number	RAW Flag	Stuff	Register Address	Stuff	Write Data or Stuff Bits	CRC	E
0	1	110100b	1	001b	0		0x42				1

Note: The host must check that the device is awake by reading the SLP_STAT bit, because it can only start an HCI transaction once the device is awake. Whenever the host suspects that the device is in deep-sleep mode, it must poll the SLP_STAT bit until receives a wake-up indication.

When the SLP_STAT bit of the Bluetooth Sleep State register is '0', it indicates the BRF device is awake.

When the SLP_STAT bit of the Bluetooth Sleep State register is '1', it indicates that the BRF device is in deep-sleep mode.

Note: The BRF device updates the SLP_STAT bit whenever it exits sleep mode, even when the host did not initiate the wake-up. This process happens whenever the device is in scan mode. In such a case, SLP_CMD = 1 and SLP_STAT = 0. If the host tries to interact with the BRF63xx device, it must write '0' to SLP_CMD to prevent the BRF63xx from going back to deep-sleep mode.

4.6 Enabling the SDIO Deep Sleep Protocol

The default setting at device power-up is that deep sleep operation is disabled. In order to enable the BRF63xx device deep sleep feature and activate the deep sleep protocol, the host must first send an HCI_VS_Set_Sleep_Mode command (see SWRU115, *BRF6350 Vendor-Specific Commands* and BT-SW-0030, *BRF6300 Vendor-Specific Commands* for more information).

```
Send_HCI_VS_Sleep_Mode_Configurations 0xFD0C, 1, 1, 0x07, 0xFF, 0xFF, 0xFF, 0, 100
```

```
Wait_HCI_Command_Complete_VS_Sleep_Mode_Configurations_Event 5000, any,
HCI_VS_Sleep_Mode_Configurations, 0x00
```

5 Shared SDIO Bus Mode

This section describes the TI solution for a system in which the SDIO Host Controller interfaces with Bluetooth (BRF63xx), WLAN (the WiLink™4.0), and DTV (DTV1000) devices (and possibly a standard SD card).

5.1 General Description

The topology consists of one SDIO master and an SDIO bus shared by several slaves (one of which may be a legacy SD card).

Standard SD/SDIO devices are referred to as ***legacy*** devices. The BT and WLAN devices are commonly identified as ***non-legacy*** SDIO devices; that is, they support the shared SDIO functionality that is described in this document.

5.2 Shared SDIO Bus Topology

The bus topology has a single master (host) and multiple slaves (SD memory card, WLAN and BT devices). The following lines are common to all SDIO devices in the system:

- SDIO_CLK
- SDIO_CMD
- SDIO_Dat0

The power and ground signals might be shared as well, depending on the electrical characteristics of the I/O cells in the host, the BRF63xx, and the WiLink™4.0. The shared SDIO bus is shown in Figure 7.

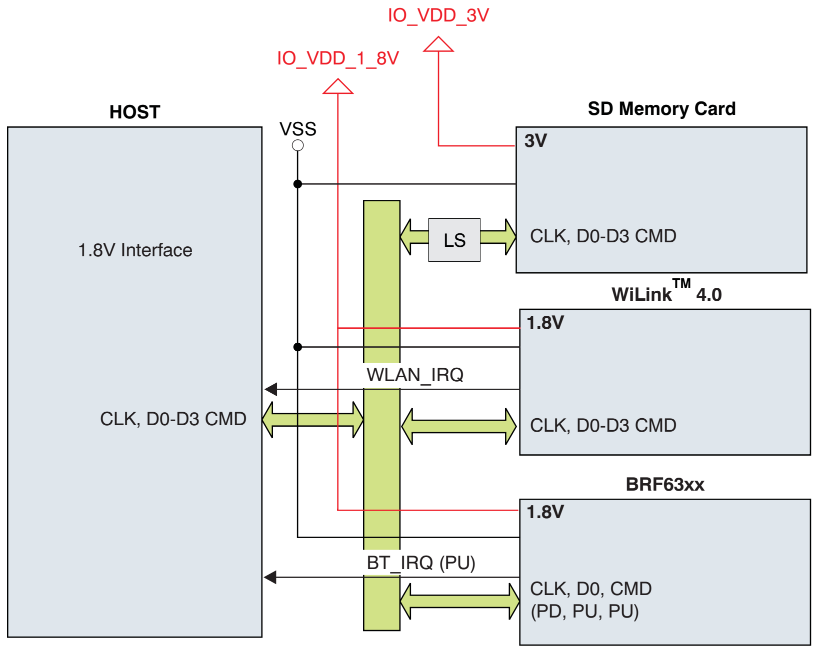

Figure 7. Shared SDIO Bus Topology

5.3 Command Format

In each non-legacy device, each function is assigned a vendor-specific (VS) command. In this way, the separation between devices and addressing the different functions in each device are assured.

Table 7 summarizes the format of a generic SDIO command.

Table 7. SDIO Command Format

Bit Position	Width (bits)	Value	Description
47	1	0	Start bit
46	1	1	Transmission bit
[45:40]	6	x	Command index
[39:8]	32	x	Argument
[7:1]	7	x	CRC7
0	1	1	End bit

The BRF63xx and WiLink 4.0 responses to the SDIO packet are in the regular SDIO format (that is, the responses present as from a legacy device).

All the mandatory commands for SDIO devices directed to a non-legacy device are re-mapped through a vendor-specific command. Three bits in the command argument define the command remapping, as shown in Table 8.

In addition, the SDIO slave in each non-legacy device holds a mechanism for auto-detection between shared and non-shared operating modes. This separation is done upon device initialization, as described in Section 5.4.

Table 8 describes the SDIO VS command format of the BRF63xx and WiLink 4.0.

Table 8. SDIO Vendor-Specific Command Format

Field Name	Description	
Start Bit	Start bit; always '0'	
Transmission Bit	Direction: 1: Indicated Host to Card 0: Indicated Card to Host	
VS Command Index	Indicates vendor-specific command with the following values (configurable). Default values should be: 60 BRF63xx - CIA Function '0' 61 BRF63xx - Data Function '1' 62 WiLink 4.0 - CIA Function '0' 63 WiLink 4.0 - Data Function '1'	
Argument	Includes all the parameters of the SDIO re-mapped command. The function number is used for indicating the re-mapped command number, according to the following matrix:	
	SDIO CMD Number (3 bits) Identify the re-mapped SDIO command:	
	000	CMD0
	001	CMD3
	010	CMD5
	011	CMD7
	100	CMD15
	101	CMD52
	110	CMD53
	111	CMD59
CRC7	Seven bits of CRC data	
E	Stop bit; always '1'	

5.3.1 Examples

Example 1. Sending CMD53 Write Command to BRF63xx Function 1 Sent From Host to Card

Table 9 depicts the command structure for this case.

Table 9. CMD53 to BRF63xx Function 1 Example

	S	D	VS Command Index	R/W Flag	Re-mapped SDIO CMD Number	Block Mode	Op Code	Register Address	Byte/Block Count	CRC	E
No of Bits	1	1	6	1	3	1	1	17	9	7	1
Value	0	1	111101	1	110	0	0	0xXXXX	000000001	0xXXX	1

Example 2. Sending CMD5 Command From Host to WiLink 4.0 Function 1

Table 10 shows the command structure for this case.

Table 10. CMD5 from WiLink 4.0 Function 1 to the Host Example

	S	D	VS Command Index	Stuff			IO OCR	CRC7	E
No of Bits	1	1	6	8			24	7	1
Value				**CMD #**					
	0	1	111111	0	010	0000	0xXXXXXX	0xXXX	1

Example 3. Sending CMD52 Read Command From BRF63xx Function 0 Sent From Host to Card:

Table 11 describes the command structure for this case.

Table 11. CMD53 to BRF63xx Function 0 Example

	S	D	VS Command Index	R/W Flag	Re-mapped SDIO CMD Number	RAW Flag	Stuff	Register Address	Stuff	Write Data or Stuff Bits	CRC	E
No of Bits	1	1	6	1	3	1	1	17	1	8	7	1
Value	0	1	111100	0	101	0	0	0xXXXX	0	00000000	0xXXX	1

5.3.2 Inter-Operability of Legacy and Non-Legacy Modes

There are two modes of operation for non-legacy devices:

1. Legacy device—only one device
2. Non-legacy device—shared mode

The SDIO slave module on the chip supports both legacy and non-legacy mode by default.

In legacy mode, the device behaves normally and responds to standard SDIO commands. In non-legacy mode, the device responds only to vendor-specific commands as described above. For this purpose, a special mechanism is incorporated into the slave device to auto-detect the operating mode during the initialization phase (see Section 5.4).

In order to prevent falsely identifying a response from another device as a legal command, there are a few mechanisms implemented within TI devices. However, there are still more actions that must be taken by the host to prevent errors:

1. The host must send VS-CMD7 to the non-legacy devices before sending a command that generates an R2 response.
2. When interfacing with a legacy device, the host must de-select the device by using CMD7 before interacting with the non-legacy devices.
3. Before and after data transaction with a non-legacy device, TI recommends that the host first select and then de-select the device via CMD7. (In cases when higher data rate is an issue, CMD7 can be eliminated.)

5.4 Initialization Process

The initialization phase is critical for the shared bus to come up successfully. Note that if the initialization sequence is initiated by means of vendor-specific commands, the device ceases to respond in legacy mode and acts only as a non-legacy device. However, if initialization occurs through CMD5, the device comes up in legacy mode.

In non-legacy mode, the initialization process follows this sequence:

- Issue vendor-specific command to first non-legacy device (device #1), with command index 5. This command initializes this device in non-legacy mode.
- Issue vendor-specific command to first non-legacy device (device #1), with command index 3, and then with command index 7 and RCA 0 to de-select the device.
- Issue vendor-specific command to next non-legacy device (device #2), with command index 5. This instruction initializes this device in non-legacy mode.
- Issue vendor-specific command to next non-legacy device (device #2), with command index 3, and then with command index 7 and RCA 0 to de-select the device.
- Issue CMD5 (SDIO card) or CMD55 (SD card) on the bus. Only the legacy device will respond because of the auto-detect functionality of non-legacy devices. However, in cases where the legacy device is not from TI, it responds with a bad CRC bit because the response R4 to the VS-CMD5 does not contain a CRC value; the legacy device mistakes it for a valid command.
- Finish initialization procedure of the legacy device.
- Send CMD7 to the legacy device to de-select it.

Now all three devices have been initialized and de-selected.

It is critical to follow the sequence as described in order for the shared bus to come up successfully. If the non-legacy mode is disabled and a VS command has been received, the device does not respond to the command. After power-up, both modes are enabled.

Figure 8 illustrates the sequence of commands when initializing a legacy and non-legacy device and the command sequence for data transaction for both types of devices.

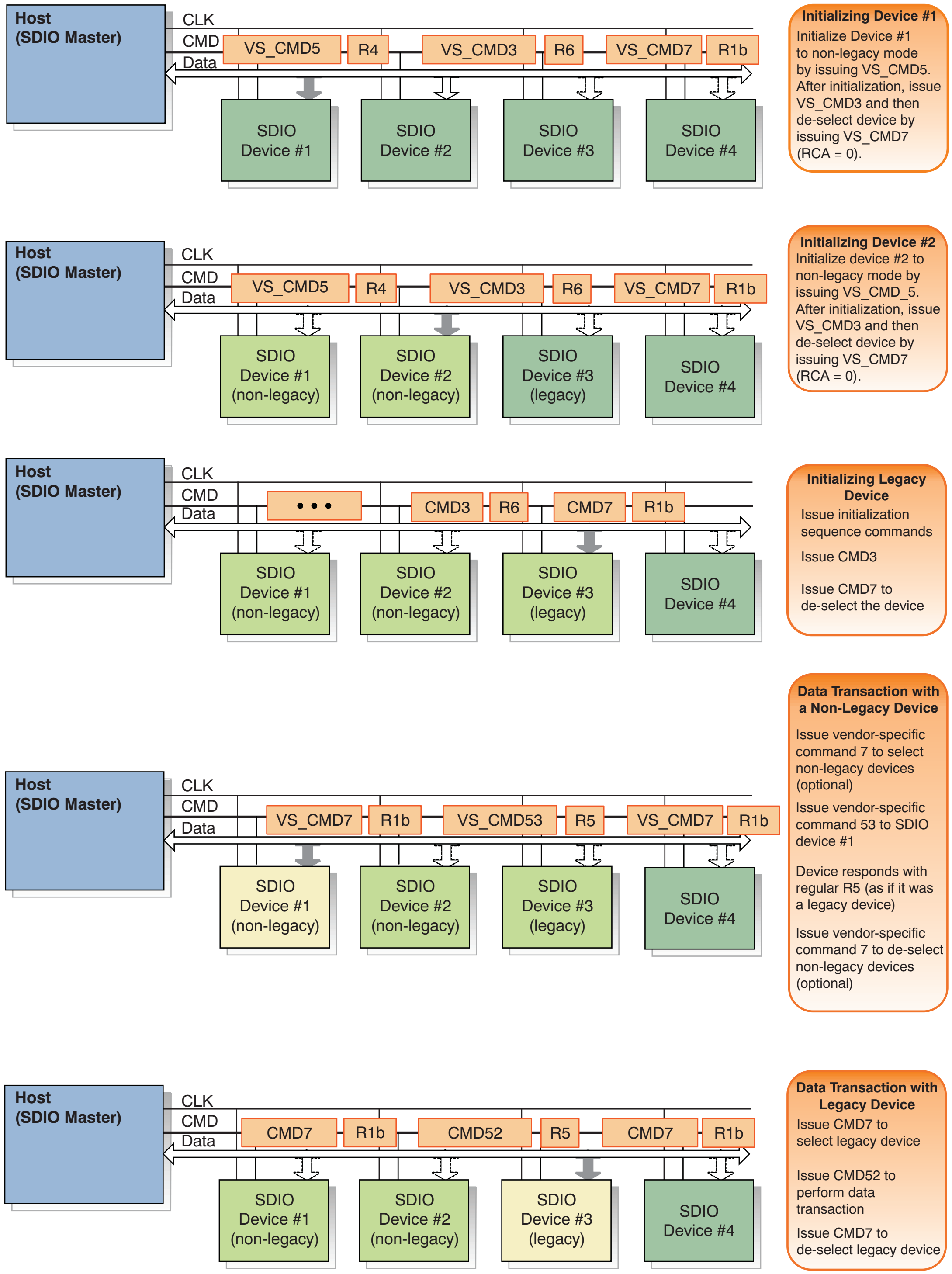

Figure 8. Initialization and Data Transfer with Legacy and Non-Legacy Devices

6 Reference Documents

Table 12 lists some of the relevant reference documents that are recommended to the user for additional information.

Table 12. Reference Documents

Literature No.	Document
	SDIO Card Specification ver1.00
	Type-A Specification for Bluetooth ver1.00
	BRF6300 Product Review
	BRF6350 Product Review v2.00
	BRF6300 HCI Vendor Specific Commands
SWRU115	BRF6350 HCI Vendor Specific Commands, v2.00

Appendix A SDIO Vendor-Specific (VS) Commands

A.1 CMD0

Table A-1. BRF63xx and WiLink 4.0 SDIO VS Command 0 Format

	S	D	VS Command Index	Stuff Bits			CRC7	E
No of Bits	1	1	6	32 [31:0]			7	1
Value				1	3 CMD#	28		

Table A-2. BRF63xx and WiLink 4.0 VS Command Fields Description for CMD0

Field Name	Description
S	Same functionality as described in SDIO Specification
D	Same functionality as described in SDIO Specification
VS Command Index	Indicates vendor-specific command with the following values (configurable), as described in Table 8.
Stuff–SDIO CMD Number	Bits [30:28] identify the re-mapped SDIO command. The rest of these bits are '0', as described in Table 8.
CRC7	Same functionality as described in SDIO Specification
E	Same functionality as described in SDIO Specification

A.2 CMD3

Table A-3. BRF63xx and WiLink 4.0 SDIO VS Command 3 Format

	S	D	VS Command Index	Stuff Bits			CRC7	E
No of Bits	1	1	6	32 [31:0]			7	1
Value				1	3 CMD#	28		

Table A-4. BRF63xx and WiLink 4.0 VS Command Fields Description for CMD3

Field Name	Description
S	Same functionality as described in SDIO Specification
D	Same functionality as described in SDIO Specification
VS Command Index	Indicates vendor-specific command with the following values (configurable), as described in Table 8.
Stuff–SDIO CMD Number	Bits [30:28] identify the re-mapped SDIO command. The rest of these bits are '0', as described in Table 8.
CRC7	Same functionality as described in SDIO Specification
E	Same functionality as described in SDIO Specification

A.3 CMD5

Table A-5. BRF63xx and WiLink 4.0 SDIO VS Command 5 Format

	S	D	VS Command Index	Stuff Bits			IO OCR	CRC7	E
No of Bits	1	1	6	8[7:0]			24	7	1
Value				1	3 CMD#	4			

Table A-6. BRF63xx and WiLink 4.0 VS Command Fields Description for CMD5

Field Name	Description
S	Same functionality as described in SDIO Specification
D	Same functionality as described in SDIO Specification
VS Command Index	Indicates vendor-specific command with the following values (configurable), as described in Table 8.
Stuff–SDIO CMD Number	Bits [6:4] identify the re-mapped SDIO command. The rest of these bits are '0', as described in Table 8.
IO OCR	Same functionality as described in SDIO Specification
CRC7	Same functionality as described in SDIO Specification
E	Same functionality as described in SDIO Specification

A.4 CMD7

Table A-7. BRF63xx and WiLink 4.0 SDIO VS Command 7 Format

	S	D	VS Command Index	RCA (Stuff Bits)			Stuff Bits (RCA)	CRC7	E
No of Bits	1	1	6	16[15:0]			16	7	1
Value				1	3 CMD#	12			

Table A-8. BRF63xx and WiLink 4.0 VS Command Fields Description for CMD7

Field Name	Description
S	Same functionality as described in SDIO Specification
D	Same functionality as described in SDIO Specification
VS Command Index	Indicates vendor-specific command with the following values (configurable), as described in Table 8.
RCA	Will be used as the Stuff bits. Bits [14:12] identify the re-mapped SDIO command. The rest of the bits are '0', as described in Table 8.
Stuff–SDIO CMD Number	Will be used in the same way as the RCA field.
CRC7	Same functionality as described in SDIO Specification
E	Same functionality as described in SDIO Specification

A.5 CMD15

Table A-9. BRF63xx and WiLink 4.0 SDIO VS Command 15 Format

	S	D	VS Command Index	RCA (Stuff Bits)			Stuff Bits (RCA)	CRC7	E
No of Bits	1	1	6	16[15:0]			16	7	1
Value				1	3 CMD#	12			

Table A-10. BRF63xx and WiLink 4.0 VS Command Fields Description for CMD15

Field Name	Description
S	Same functionality as described in SDIO Specification
D	Same functionality as described in SDIO Specification
VS Command Index	Indicates vendor-specific command with the following values (configurable), as described in Table 8.
RCA	Will be used as the Stuff bits. Bits [14:12] identify the re-mapped SDIO command. The rest of the bits are '0' as described in Table 8
Stuff–SDIO CMD Number	Will be used in the same way as the RCA field.
CRC7	Same functionality as described in SDIO Specification
E	Same functionality as described in SDIO Specification

A.6 CMD52

Table A-11. BRF63xx and WiLink 4.0 SDIO VS Command 52 Format

	S	D	VS Command Index	R/W Flag	Re-mapped SDIO CMD Number	RAW Flag	Stuff	Register Address	Stuff	Write Data or Stuff Bits	CRC7	E
No of Bits	1	1	6	1	3	1	1	17	1	8	7	1
Value												

Table A-12. BRF63xx and WiLink 4.0 VS Command Fields Description for CMD52

Field Name	Description
S	Same functionality as described in SDIO Specification
D	Same functionality as described in SDIO Specification
VS Command Index	Indicates vendor-specific command with the following values (configurable), as described in Table 8.
R/W Flag	Same functionality as described in SDIO Specification
SDIO CMD Number	Identify the re-mapped SDIO Command, as described in Table 8.
RAW Flag	Same functionality as described in SDIO Specification
Stuff	Same functionality as described in SDIO Specification
Register Address	Same functionality as described in SDIO Specification
Stuff	Same functionality as described in SDIO Specification
Write Data or Stuff Bits	Same functionality as described in SDIO Specification
CRC7	Same functionality as described in SDIO Specification
E	Same functionality as described in SDIO Specification

A.7 CMD53

Table A-13. BRF63xx and WiLink 4.0 SDIO VS Command 53 Format

	S	D	VS Command Index	R/W Flag	Re-mapped SDIO CMD Number	Block Mode	OpCode	Register Address	Byte/Block Count	CRC7	E
No of Bits	1	1	6	1	3	1	1	17	9	7	1
Value											

Table A-14. BRF63xx and WiLink 4.0 VS Command Fields Description for CMD53

Field Name	Description
S	Same functionality as described in SDIO Specification
D	Same functionality as described in SDIO Specification
VS Command Index	Indicates vendor-specific command with the following values (configurable), as described in Table 8.
R/W Flag	Same functionality as described in SDIO Specification
SDIO CMD Number	Identify the re-mapped SDIO Command, as described in Table 8.
Block Mode	Same functionality as described in SDIO Specification
Op Code	Same functionality as described in SDIO Specification
Register Address	Same functionality as described in SDIO Specification
Byte/Block Count	Same functionality as described in SDIO Specification
CRC7	Same functionality as described in SDIO Specification
E	Same functionality as described in SDIO Specification

A.8 CMD59

Table A-15. BRF63xx and WiLink 4.0 SDIO VS Command 59 Format

	S	D	VS Command Index	Stuff Bits			CRC7	E
No of Bits	1	1	6	32 [31:0]			7	1
Value				1	3 CMD#	28		

Table A-16. BRF63xx and WiLink 4.0 VS Command Fields Description for CMD59

Field Name	Description
S	Same functionality as described in SDIO Specification
D	Same functionality as described in SDIO Specification
VS Command Index	Indicates vendor-specific command with the following values (configurable), as described in Table 8.
Stuff–SDIO CMD Number	Bits [30:28] identify the re-mapped SDIO command. The rest of these bits are '0,' as described in Table 8.
CRC7	Same functionality as described in SDIO Specification
E	Same functionality as described in SDIO Specification

Appendix B Code Example—Fixing the Type-A Header Issue

```
/*
typedef struct _SD_TRANSPORT_HEADER {
    union {
        struct {
            UCHAR   PacketLength[3];
            UCHAR   ServiceID;
        } AsUCHAR;
        ULONG   AsULONG;
    } u;
} SD_TRANSPORT_HEADER, *PSD_TRANSPORT_HEADER;
*/

This is the code AFTER the fix
typedef struct _SD_TRANSPORT_HEADER {
    union {
                        struct {
                                    UCHAR   ServiceID;
                                    UCHAR   PacketLength[3];
                        } AsUCHAR;
        ULONG   AsULONG;
    } u;
} SD_TRANSPORT_HEADER, *PSD_TRANSPORT_HEADER; //krishna interchanged serviceid and
PacketLength
```

Appendix C SDIO Interface Timing Information

C.1 BRF6300 SDIO Interface Timing

Figure C-1 shows the BRF6300 SDIO timing. Table C-1 specifies the BRF6300 SDIO interface timing parameters.

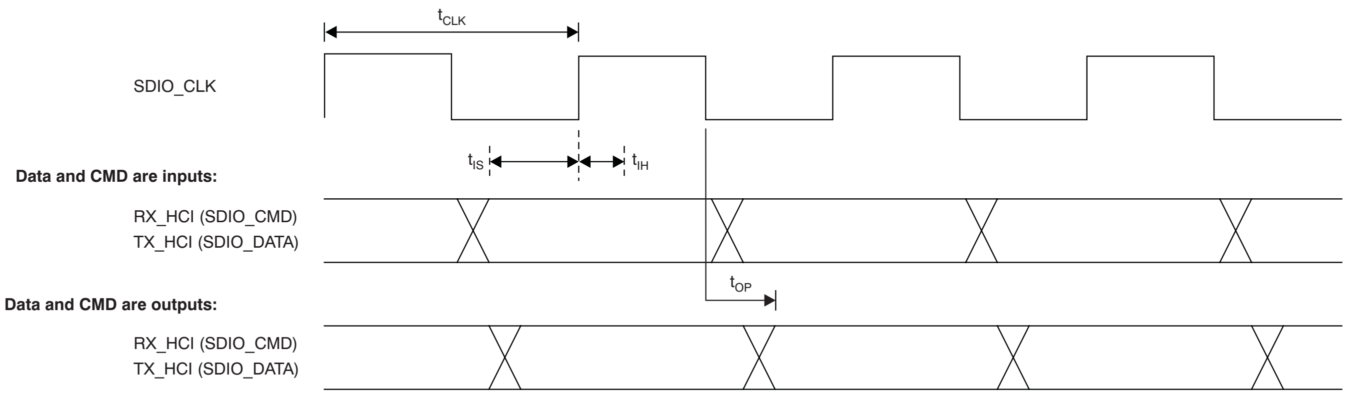

Figure C-1. BRF6300 SDIO Interface Timing

Table C-1. BRF6300 SDIO Interface Timing Parameters

SYMBOL	PARAMETER	MIN	MAX	UNIT	LOAD
t_{CLK}	Cycle time (50% duty cycle)	50.0 (20MHZ)		ns	
t_{CLK}	Cycle time (40% duty cycle)	62.5 (16MHz)		ns	
t_{IS}	SDIO CMD setup time		5		
t_{IH}	SDIO CMD hold time	0			
t_{IS}	SDIO DATA setup time		5		
t_{IH}	SDIO DATA hold time	0			
t_{OP}	SDIO CMD propogation time	3	18		25pF
t_{OP}	SDIO DATA propogation time	3.5	18		25pF

C.2 BRF6350 SDIO Interface Timing

Figure C-2 shows the SDIO interface timing for the BRF6350. Table C-2 specifies the BRF6350 SDIO interface timing parameters.

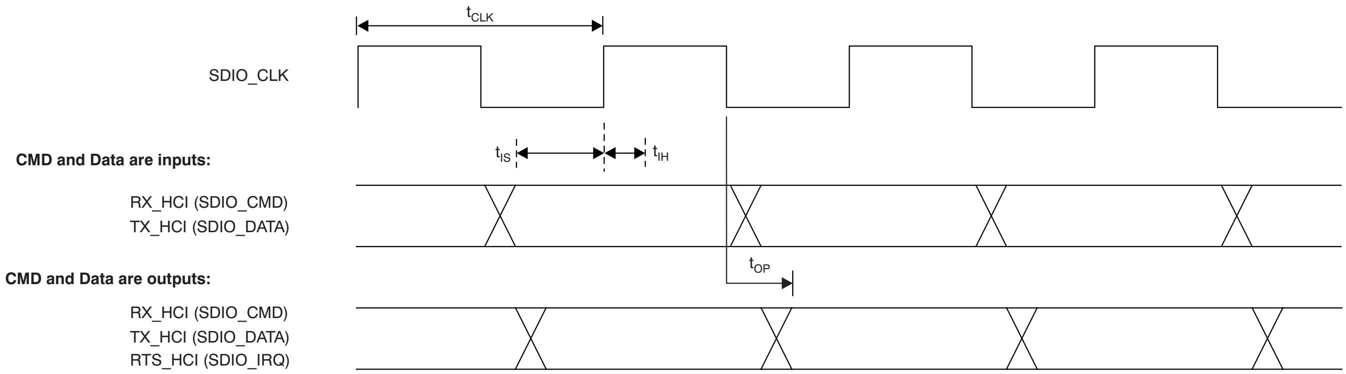

Figure C-2. BRF6350 SDIO Interface Timing

Table C-2. BRF6350 SDIO Interface Timing Parameters

SYMBOL	PARAMETER	MIN	MAX	UNIT	LOAD
t_{CLK}	Cycle time	40		ns	
t_{IS}	CMD/DATA setup time	5		ns	
t_{IH}	CMD/DATA hold time	5		ns	
t_{OP}	CMD/DATA/IRQ propagation time	0	14	ns	25pF

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