

Absolute Maximum Ratings

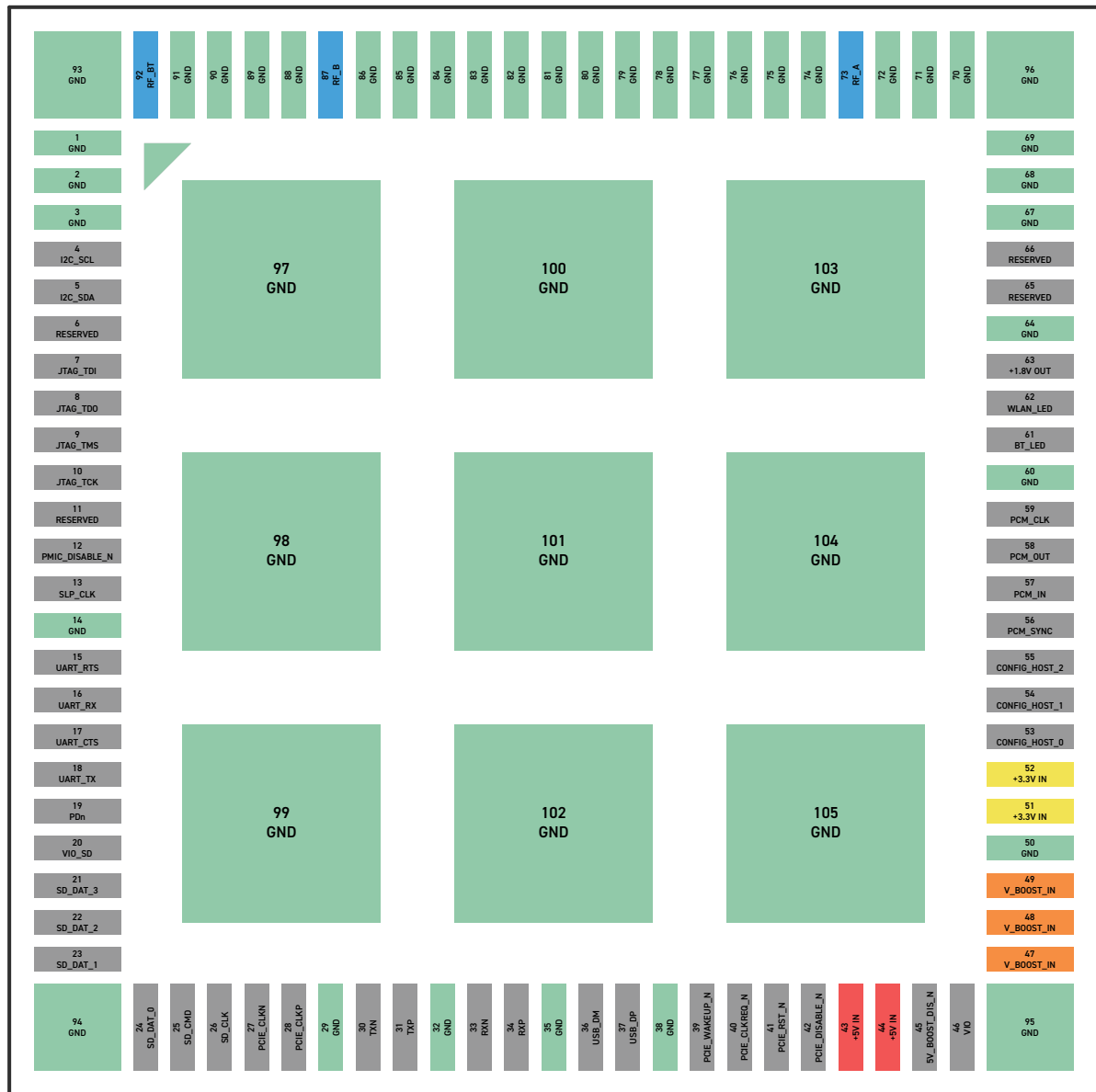
Parameter	Symbol	Max Rating	Units
External 3.3V Power Supply	3.3V	4.0	V
I/O Power Supply in 1.8V Config	VIO (1.8V)	2.2	V
I/O Power Supply in 3.3V Config	VIO (3.3V)	4.0	V
SDIO Power Supply in 1.8V Config	VIO_SD (1.8V)	2.2	V
SDIO Power Supply in 3.3V Config	VIO_SD (3.3V)	4.0	V
External 5V Power Supply	5V	6.0	V
Module Boost Converter Power Input	V_BOOST_IN	4.7	V
Storage Temperature	Storage Temperature	-40 to +85	°C

Recommended Operating Conditions

Parameter	Symbol	Min Rating	Typical	Max Rating	Units
External 3.3V Power Supply	3.3V	2.97	3.3	3.63	V
I/O Power Supply in 1.8V Config	VIO (1.8V)	1.62	1.8	1.98	V
I/O Power Supply in 3.3V Config	VIO (3.3V)	2.97	3.3	3.47	V
SDIO Power Supply in 1.8V Config	VIO_SD (1.8V)	1.62	1.8	1.98	V
SDIO Power Supply in 3.3V Config	VIO_SD (3.3V)	2.97	3.3	3.47	V
External 5V Power Supply	5V	4.75	5.0	5.25	V
Module Boost Converter Power Input	V_BOOST_IN	2.7	3.3	4.5	V
HIGH Level Input Voltage (for VIO=1.8V)	$V_{IH(1.8V)}$	$0.7 \cdot VIO_{1.8V}$	-	$VIO_{1.8V} + 0.4$	V
LOW Level Input Voltage (for VIO=1.8V)	$V_{IL(1.8V)}$	-0.4	-	$0.3 \cdot VIO_{1.8V}$	V
Input Hysteresis (for VIO=1.8V)	$V_{HYS(1.8V)}$	100	-	-	mV
HIGH Level Output Voltage (for VIO=1.8V)	$V_{OH(1.8V)}$	$VIO_{1.8V} - 0.4$	-	-	V
LOW Level Output Voltage (for VIO=1.8V)	$V_{OL(1.8V)}$	-	-	0.4	V
HIGH Level Input Voltage (for VIO=3.3V)	$V_{IH(3.3V)}$	$0.7 \cdot VIO_{3.3V}$	-	$VIO_{3.3V} + 0.4$	V
LOW Level Input Voltage (for VIO=3.3V)	$V_{IL(3.3V)}$	-0.4	-	$0.3 \cdot VIO_{3.3V}$	V
Input Hysteresis (for VIO=3.3V)	$V_{HYS(3.3V)}$	100	-	-	mV
HIGH Level Output Voltage (for VIO=3.3V)	$V_{OH(3.3V)}$	$VIO_{3.3V} - 0.4$	-	-	V
LOW Level Output Voltage (for VIO=3.3V)	$V_{OL(3.3V)}$	-	-	0.4	V
Operating Temperature	Operating Temp.	-40	+25	+85	°C
Operating Humidity	Operating Humidity	20	50	90	%

Module Pin Diagram

The diagram below represents the Top View of the Sparrow Module and contains the pin numbers with pin assignments. Pin definitions and descriptions can be found on the next page. For detailed mechanical drawings, see the "Mechanical Drawing" section.



LGA MODULE - TOP VIEW

Module Pin Definitions

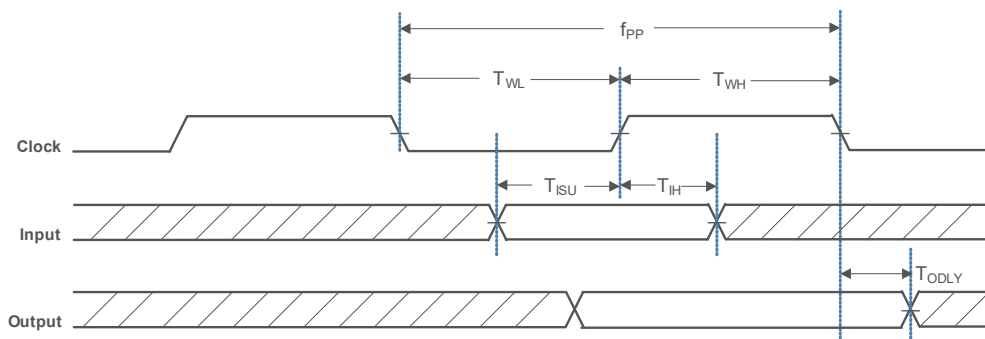
Pin #	Assignment	Description	Voltage Ref.	Pin Type	If Not Used
1	GND	Ground	-	-	GND
2	GND	Ground	-	-	GND
3	GND	Ground	-	-	GND
4	I2C_SCL	I2C Clock Signal	VIO	I/O, PU	NC
5	I2C_SDA	I2C Data	VIO	I/O, PU	NC
6	RESERVED	Reserved, Do Not Connect	-	-	NC
7	JTAG_TDI	JTAG Data IN / LTE_SIN	VIO	I, PU	NC
8	JTAG_TDO	JTAG Data OUT / LTE_SOUT	VIO	O, PD	NC
9	JTAG_TMS	JTAG TMS	VIO	I, PU	NC
10	JTAG_TCK	JTAG TCK	VIO	I, PU	NC
11	RESERVED	Reserved, Do Not Connect	-	-	NC
12	PMIC_DISABLE_N	Disables the internal regulators if driven low, shutting down the device. Has internal weak pullup to 3.3V	3.3V	I, PU	NC
13	SLP_CLK	Sleep Clock Input, Connect 32.768kHz	VIO	I, PU	NC
14		for optional power saving mode			
15	GND	Ground	-	-	GND
16	UART_RTSn	BT UART Request to Send, active low	VIO	O, PU	NC
17	UART_RX	BT UART Device RX	VIO	I, PU	NC
18	UART_CTSn	BT UART Clear to Send, active low	VIO	I, PU	NC
19	UART_TX	BT UART Device TX	VIO	O, PU	NC
20	PDn	Powers down the radio chipset if driven low. Has internal weak pullup to VIO.	VIO	I, PU	NC
21					
22	VIO_SD	SDIO Power Supply for I/O - 1.8V or 3.3V	-	Power	NC
23	SD_DAT_3	SDIO Data Line Bit 3	VIO_SD	I/O, PU	NC
24	SD_DAT_2	SDIO Data Line Bit 2	VIO_SD	I/O, PU	NC
25	SD_DAT_1	SDIO Data Line Bit 1	VIO_SD	I/O, PU	NC
26	SD_DAT_0	SDIO Data Line Bit 0	VIO_SD	I/O, PU	NC
27	SD_CMD	SDIO Command	VIO_SD	I/O, PU	NC
28	SD_CLK	SDIO Clock Input	VIO_SD	I, PU	NC

Pin #	Assignment	Description	Voltage Ref.	Pin Type	If Not Used
29	GND	Ground	-	-	GND
30	TXN	USB3 / PCIe TX Data Negative	1.8V	O	NC
31	TXP	USB3 / PCIe TX Data Positive	1.8V	O	NC
32	GND	Ground	-	-	GND
33	RXN	USB3 / PCIe RX Data Negative	1.8V	I	NC
34	RXP	USB3 / PCIe RX Data Positive	1.8V	I	NC
35	GND	Ground	-	-	GND
36	USB_DN	USB2.0 Data Negative	3.3V	I/O	NC
37	USB_DP	USB2.0 Data Plus	3.3V	I/O	NC
38	GND	Ground	-	-	GND
39	PCIE_WAKEn	PCle Wake Signal (active low)	3.3V	I/O	NC
40	PCIE_CLKREQn	PCle Clock Request Signal (active low)	3.3V	I/O	NC
41	PCIE_PERSTn	PCle Reset (active low)	VIO	I	NC
42	PCIE_W_DISABLEn	Disables WLAN function of device. Can be used as RF Kill (PCle Mode Only)	VIO	I	NC
43	5V	Module +5V input/output. This is an	-	Power	NC
44	5V	input if 5V_BOOST_DIS_N is driven LOW.	-	Power	NC
45	5V_BOOST_DIS_N	Disables the internal boost converter if external +5V source is supplied to module.	V_BOOST_IN	I	NC
46	VIO	1.8V/2.5V/3.3V Digital I/O Power Supply	-	Power	-
47	V_BOOST_IN	Internal Boost Converter power supply.	-	Power	NC
48	V_BOOST_IN	Suggested voltage is 3.3V - see detailed	-	Power	NC
49	V_BOOST_IN	specifications for acceptable range.	-	Power	NC
50	GND	Ground	-	-	GND
51	3.3V	3.3V Module Power Supply	-	Power	-
52	3.3V		-	Power	-
53	CONFIG_HOST_0	Host Interface Config Strapping Pins.	1.8V	I, PU	NC
54	CONFIG_HOST_1	See "Config Host Pins" section for	1.8V	I, PU	NC
55	CONFIG_HOST_2	detailed usage.	1.8V	I, PU	NC
56	PCM_SYNC	PCM Sync Pulse Signal	VIO	I/O, PU	NC
57	PCM_IN	PCM Data Input	VIO	I, PU	NC
58	PCM_OUT	PCM Data Output	VIO	O, PU	NC
59	PCM_CLK	PCM Clock Signal	VIO	I/O, PU	NC

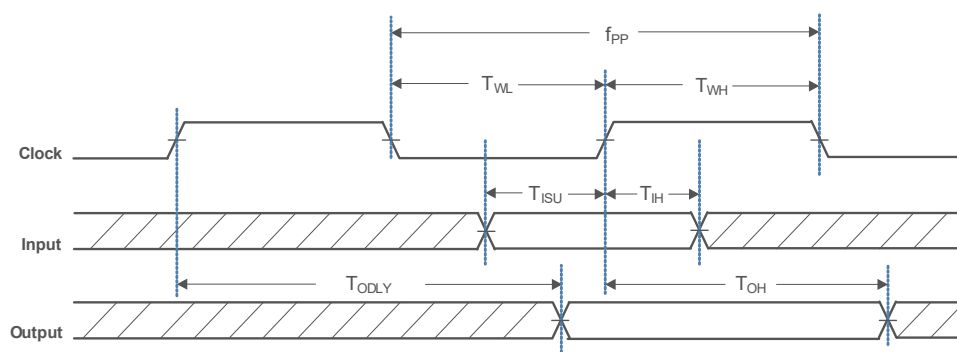
Pin #	Assignment	Description	Voltage Ref.	Pin Type	If Not Used
60	GND	Ground	-	-	GND
61	BT_LED	Bluetooth Activity LED Output 10 mA drive capable, active LOW	VIO	O, PU	NC
62	WLAN_LED	Wi-Fi Activity LED Output 10 mA drive capable, active LOW	VIO	O, PU	NC
63	1.8V	1.8V Output from Internal PMIC. Only used as a 1.8V reference source for connction to VIO or level shifters.	-	O	NC
64	GND	Ground	-	-	GND
65	RESERVED	Reserved, Do Not Connect	-	-	NC
66	RESERVED	Reserved, Do Not Connect	-	-	NC
67-72	GND	Ground	-	-	GND
73	RF_A	RF Transmit / Receive Path 1 (Wi-Fi Only)	-	RF	50Ω Load
74-86	GND	Ground	-	-	GND
87	RF_B	RF Transmit / Receive Path 2 (Wi-Fi Only)	-	RF	50Ω Load
88-91	GND	Ground	-	-	GND
92	RF_BT	Bluetooth RF Transmit / Receive Path	-	RF	50Ω Load
93-105	GND	Ground	-	-	GND

SDIO Interface Specifications

SDIO Protocol Timing Diagram—Default Speed Mode (3.3V)

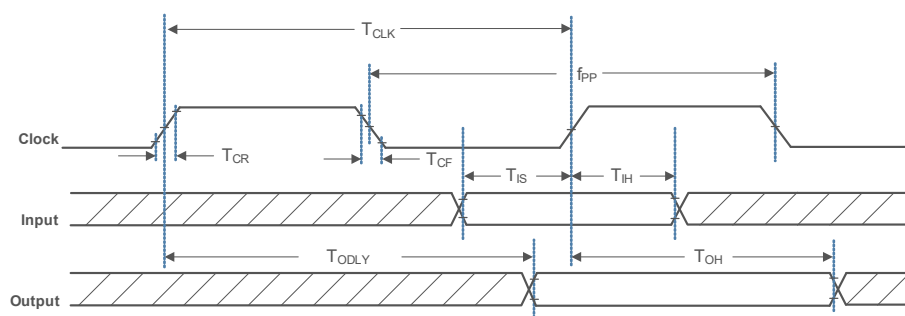


SDIO Protocol Timing Diagram—High-Speed Mode (3.3V)



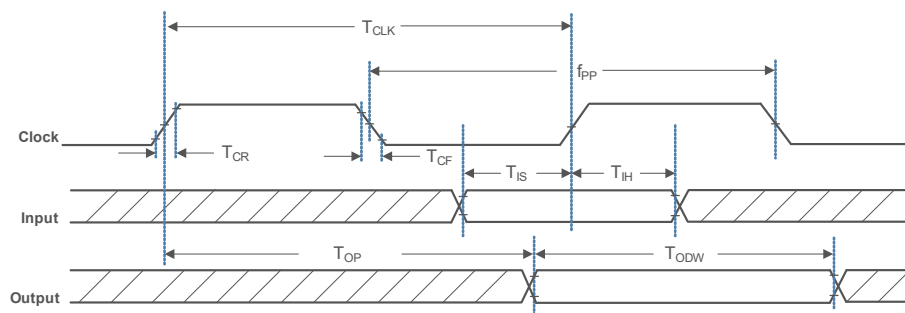
Symbol	Parameter	Condition	Min	Typ	Max	Units
f_{PP}	Clock frequency	Normal	0	--	25	MHz
		High-speed	0	--	50	MHz
T_{WL}	Clock low time	Normal	10	--	--	ns
		High-speed	7	--	--	ns
T_{WH}	Clock high time	Normal	10	--	--	ns
		High-speed	7	--	--	ns
T_{ISU}	Input setup time	Normal	5	--	--	ns
		High-speed	6	--	--	ns
T_{IH}	Input hold time	Normal	5	--	--	ns
		High-speed	2	--	--	ns
T_{ODLY}	Output delay time	Normal	--	--	14	ns
	CL $\leq$ 40 pF (1 card)	High-speed	--	--	14	ns
T_{OH}	Output hold time	High-speed	2.5	--	--	ns

SDR12, SDR25, SDR50 Modes (up to 100MHz) (1.8V)



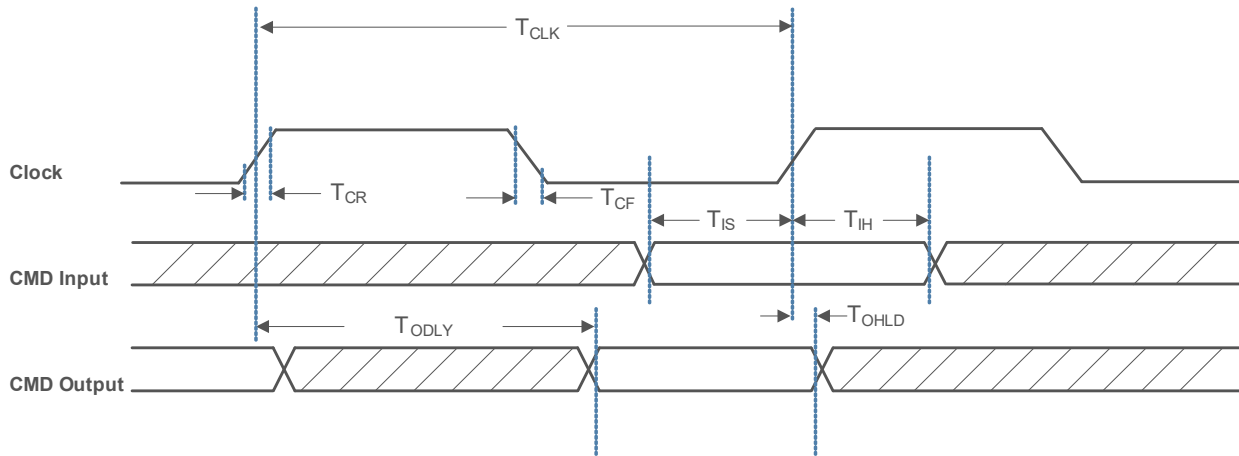
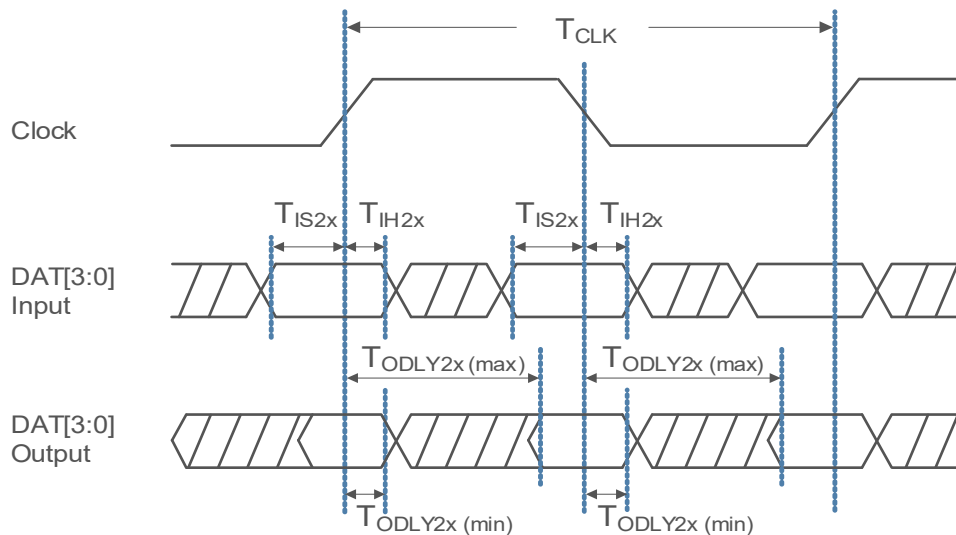
Symbol	Parameter	Condition	Min	Typ	Max	Units
f_{PP}	Clock frequency	SDR12/25/50	25	--	100	MHz
T_{IS}	Input setup time	SDR12/25/50	3	--	--	ns
T_{IH}	Input hold time	SDR12/25/50	0.8	--	--	ns
T_{CLK}	Clock time	SDR12/25/50	10	--	40	ns
T_{CR}, T_{CF}	Rise time, fall time $T_{CR}, T_{CF} < 2$ ns (max) at 100 MHz $C_{CARD} = 10$ pF	SDR12/25/50	--	--	$0.2 \cdot T_{CLK}$	ns
T_{ODLY}	Output delay time $C_L \leq 30$ pF	SDR12/25/50	--	--	7.5	ns
T_{OH}	Output hold time $C_L = 15$ pF	SDR12/25/50	1.5	--	--	ns

SDR12, SDR25, SDR50 Modes (up to 100MHz) (1.8V)



Symbol	Parameter	Condition	Min	Typ	Max	Units
f_{PP}	Clock frequency	SDR104	0	--	208	MHz
T_{IS}	Input setup time	SDR104	1.4	--	--	ns
T_{IH}	Input hold time	SDR104	0.8	--	--	ns
T_{CLK}	Clock time	SDR104	4.8	--	--	ns
T_{CR}, T_{CF}	Rise time, fall time $T_{CR}, T_{CF} < 0.96$ ns (max) at 208 MHz $C_{CARD} = 10$ pF	SDR104	--	--	$0.2 \cdot T_{CLK}$	ns
T_{OP}	Card output phase	SDR104	0	--	10	ns
T_{ODW}	Output timing of variable data window	SDR104	2.88	--	--	ns

SDIO CMD Timing Diagram—DDR50 Mode (50MHz)

SDIO DAT[3:0] Timing Diagram—DDR50 Mode¹ (50MHz)

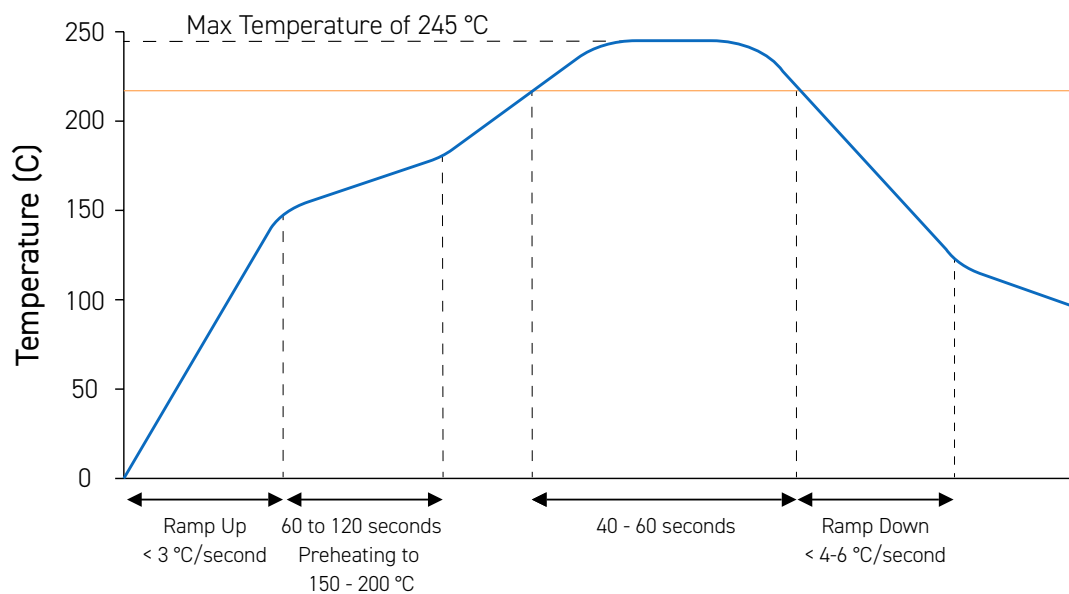
1. In DDR50 mode, DAT[3:0] lines are sampled on both edges of the clock (not applicable for CMD line).

SDIO Timing Data—DDR50 Mode (50MHz)

Symbol	Parameter	Condition	Min	Typ	Max	Units
Clock						
T _{CLK}	Clock time 50 MHz (max) between rising edges	DDR50	20	--	--	ns
T _{CR} , T _{CF}	Rise time, fall time T _{CR} , T _{CF} < 4.00 ns (max) at 50 MHz C _{CARD} = 10 pF	DDR50	--	--	0.2*T _{CLK}	ns
Clock Duty	--	DDR50	45	--	55	%
CMD Input (referenced to clock rising edge)						
T _{IS}	Input setup time C _{CARD} ≤ 10 pF (1 card)	DDR50	6	--	--	ns
T _{IH}	Input hold time C _{CARD} ≤ 10 pF (1 card)	DDR50	0.8	--	--	ns
CMD Output (referenced to clock rising edge)						
T _{ODLY}	Output delay time during data transfer mode C _L ≤ 30 pF (1 card)	DDR50	--	--	13.7	ns
T _{OHLD}	Output hold time C _L ≥ 15 pF (1 card)	DDR50	1.5	--	--	ns
DAT[3:0] Input (referenced to clock rising and falling edges)						
T _{IS2x}	Input setup time C _{CARD} ≤ 10 pF (1 card)	DDR50	3	--	--	ns
T _{IH2x}	Input hold time C _{CARD} ≤ 10 pF (1 card)	DDR50	0.8	--	--	ns
DAT[3:0] Output (referenced to clock rising and falling edges)						
T _{ODLY2x (max)}	Output delay time during data transfer mode C _L ≤ 25 pF (1 card)	DDR50	--	--	7.0	ns
T _{ODLY2x (min)}	Output hold time C _L ≥ 15 pF (1 card)	DDR50	1.5	--	--	ns

Storage, Handling, & Reflow Profile

Recommended Reflow Profile



Ordering Information

Part Number

Description

SP-01-100

22 mm x 22 mm LGA Module
Tape & Reel Packaging

SP-01-100-M2

22 mm x 42 mm M.2 Key E Module
Individually Packed ESD Bags

SP-01-100-EVK

Evaluation Kit
Individually Packed ESD Bags

NOTICE

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as shown in User manual.

L'intégrateur OEM doit s'assurer de ne pas fournir d'informations à l'utilisateur final sur la façon d'installer ou de retirer ce module RF dans le manuel d'utilisation du produit final qui intègre ce module. Le manuel de l'utilisateur final doit inclure toutes les informations/avertissements réglementaires requis, tel qu'indiqué dans le manuel de l'utilisateur.

UNLICENSED RADIATOR / LICENSE-EXEMPT RADIATOR

This device complies with Part 15 of the FCC Rules.

Operation is subject to the following two conditions:

- 1) this device may not cause harmful interference and
- 2) this device must accept any interference received, including interference that may cause undesired operation.

You are cautioned that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

1. This device may not cause interference, and
2. This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

1. l'appareil ne doit pas produire de brouillage, et
2. l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

LIST OF APPLICABLE FCC RULES

This module has been tested and found to comply with the following requirements for Modular Approval.

- 47 CFR Part 15 Subpart C Intentional Radiators
- 47 CFR Part 15 Subpart E Unlicensed National Information Infrastructure Devices

SUMMARIZE THE SPECIFIC OPERATIONAL USE CONDITIONS

The host device's end-user manual must include all applicable regulatory notices and statements as required by the specific rules governing this module.

RF EXPOSURE CONSIDERATIONS

1. The host product operating conditions must be such that there is a minimum separation distance of 20 cm (or possibly greater than 20 cm) between the antenna radiating structures and nearby persons. The host manufacturer is obligated to confirm the use conditions of the host product to ensure that the distance specified in the instructions is met. In this case the host product is classified as either a mobile device or a fixed device for RF exposure purposes.
 2. If the modular transmitter to be used in a specific type of host platform and installed such that it can be operated at closer than 20 cm to users or nearby persons, please follow below guidance.
 - a. For the host product integrated with this modular transmitter as a stand-alone configuration, the maximum conducted power from the original grant shall be retained in order to meet SAR exemption requirements.
 - b. For configuration with multiple transmitters in the same host, routine evaluation or SAR testing for the simultaneous transmission of the co-located transmitters according to KDB 447498 is required. The portable host product shall be evaluated for ensuring to continue compliance FCC rule part 2.1093 & part 1.1310 by C2PC. The additional guidance for the portable host products is provided in KDB Publication 996369 D02 and D04.
 - c. For the host product is not installed according to this guide, the module certification will be invalid, and a new grant certification will be required for the host product.
-
1. Les conditions de fonctionnement du produit hôte doivent être telles qu'il existe une distance de séparation minimale de 20 cm (ou éventuellement supérieure à 20 cm) entre les structures rayonnantes de l'antenne et les personnes à proximité. Le fabricant hôte est tenu de confirmer les conditions d'utilisation du produit hôte pour s'assurer que la distance spécifiée dans les instructions est respectée. Dans ce cas, le produit hôte est classé comme un appareil mobile ou un appareil fixe aux fins d'exposition aux RF.
 2. Si l'émetteur modulaire doit être utilisé sur un type spécifique de plateforme hôte et installé de manière à pouvoir être utilisé à moins de 20 cm des utilisateurs ou des personnes à proximité, veuillez suivre les instructions ci-dessous.
 - a. Pour le produit hôte intégré à cet émetteur modulaire en tant que configuration autonome, la puissance conduite maximale de la subvention d'origine doit être conservée afin de répondre aux exigences d'exemption SAR.
 - b. Pour une configuration avec plusieurs émetteurs dans le même hôte, une évaluation de routine ou un test SAR pour la transmission simultanée des émetteurs colocalisés conformément à la norme KDB 447498 est nécessaire. Le produit hôte portable doit être évalué pour garantir le maintien de la conformité par un changement permissif ultérieur. Des instructions supplémentaires pour les produits hôtes portables sont fournies dans la publication KDB 996369 D02 et D04.
 - c. Si le produit hôte n'est pas installé conformément à ce guide, la certification du module sera invalide et une nouvelle certification sera requise pour le produit hôte.

ANTENNAS

This radio transmitter has been approved by Federal Communications Commission and Innovation, Science and Economic Development Canada to operate with the antenna types

listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Cet émetteur radio a été approuvé par la Commission fédérale des communications et Innovation, Sciences et Développement économique Canada pour fonctionner avec les types d'antennes énumérés ci-dessous, avec le gain maximal autorisé indiqué. Les types d'antennes non mentionnés dans cette liste dont le gain est supérieur au gain maximal indiqué pour l'un des types énumérés sont strictement interdits avec cet appareil.

Antenna Type	Supplier	Antenna Part No.	Freq. (MHz)	Peak Antenna Gain (dBi)
Flexible Printed Circuit	ABRACON	AFG4507W2	2400~2500	6.62
			5150~5250	7.68
			5250~5350	8.12
			5470~5725	8.12
			5725~5850	6.91
			5850~5895	6.91

LABEL AND COMPLIANCE INFORMATION

The host device integrating this module must be labeled with the following regulatory identifiers to ensure compliance with regulations, these labels must be clearly visible on the exterior of the host device's enclosure as required by applicable regulatory guidelines.

Le dispositif hôte intégrant ce module doit être étiqueté avec les identifiants réglementaires suivants pour garantir la conformité aux règlements, ces étiquettes doivent être clairement visibles à l'extérieur du boîtier du dispositif hôte comme l'exigent les directives réglementaires applicables.

Contains FCC ID: 2BPPF-SP01

Contains IC: 34356-SP01

INFORMATION ON TEST MODES AND ADDITIONAL TESTING REQUIREMENTS

The module can be configured to continuously transmit on a specific frequency with a fixed modulation pattern. This allows evaluation of radiated emissions and spurious emissions in a controlled condition.

These test modes are intended for compliance testing only and must not be enabled during normal operation of the final product.

For more detailed information, please contact the grantee for assistance with test modes needed for module/host compliance test requirements.

ADDITIONAL TESTING, PART 15 SUBPART B DISCLAIMER

The modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible

for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification.

The final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

NOTE EMI CONSIDERATIONS

Note that a host manufacture is recommended to use KDB996369 D04 Module Integration Guide recommending as "best practice" RF design engineering testing and evaluation in case non-linear interactions generate additional non-compliant limits due to module placement to host components or properties.

For standalone mode, reference the guidance in KDB996369 D04 Module Integration Guide and for simultaneous mode; see KDB996369 D02 Module Q&A Question 12, which permits the host manufacturer to confirm compliance.

HOW TO MAKE CHANGES

Only Grantees are permitted to make permissive changes, if the module will be used differently than granted conditions, please contact us to ensure modifications will not affect compliance.