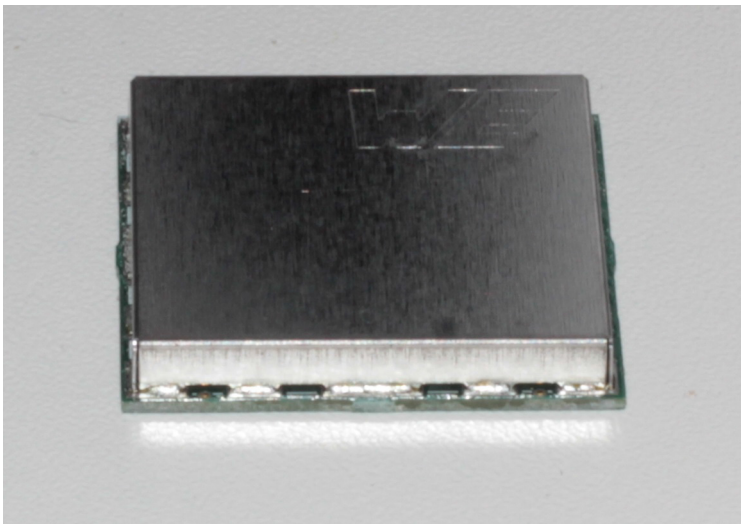
Hiberband modem

Key features

- Compact, ultra low-power SMT module design
- Hiberband RF signal and baseband processing
- Interface for direct connection of a GNSS receiver module
- Geolocation-based satellite tracking algorithm
- Serial UART-based host processor interface



Functional description

The Hiberband modem is a highly integrated, low-power communications front-end designed for global delivery of sensor data through Hiber's satellite-based Hiberband Low-Power Global Area Network (LPGAN). Designed as a compact, solderable SMT module, it is straightforward to integrate in IoT devices. The application host processor of the IoT device interacts with the Hiberband modem through a UART-based serial interface using a command-response protocol.

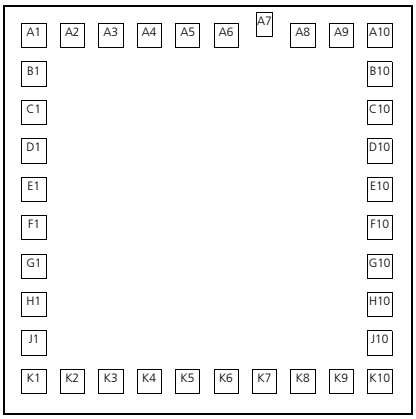
The Hiberband modem operates in one of several modes, each with their own distinctive power consumption pattern:

- **Hibernation Mode**: the Hiberband modem will be in this mode most the time; with exception of its internal real-time clock, all systems are shut off.
- **Host Communication Mode**: the Hiberband modem has activated the minimal set of functions needed to receive instructions (e.g. to submit sensor data for transmission) from the application host processor.
- **Geo-location Mode**: the Hiberband modem will autonomously activate a connected GNSS receiver to re-determine its current location to stay synchronized with the Hiberband network of orbiting satellites.
- **Hiberband Listen Mode**: the Hiberband modem has activated its receiver in anticipation of a satellite passing overhead.
- **Hiberband Transmission Mode**: the Hiberband modem has activated its Hiberband transmitter to send sensor data to a satellite in range.

The highly energy-efficient operation of the Hiberband modem is supported by an advanced orbit prediction algorithm that allows it to remain in hibernation mode until one of the Hiberband satellites becomes 'visible' to the The highly energy-efficient operation of the Hiberband-enabled IoT device. The optimal communication window is determined by the current geographic location of the device; to keep track of the actual location, the Hiberband modem is equipped with an interface for direct control of a suitable GNSS receiver. This geo-position information acquired by the Hiberband modem is also available to the IoT device application through the host processor interface.

For the integration details of the Hiberband LPGAN modem in your IoT device, please refer to the Hiber System Integration Manual (on support.hiber.global).

1 Hiberband modem pin-assignment



The pin numbering scheme of the Hiberband LPGAN modem (bottom view) is shown in figure 1. The module footprint is a Land Grid Array (LGA) that allows soldering onto a printed circuit board (PCB) using standard reflow manufacturing techniques.

The pin function assignment is given in table 1.

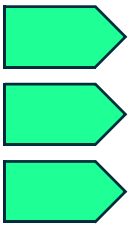
Figure 1: Hiberband modem pin numbering scheme

Function	Pin name	I/O	Description	Hiberband modem pin numbers
Power/RF	VCC	I	Supply voltage	A1, A2, B1, B10
	GND	n/a	Ground	A3, A4, A5, A6, A8, A9, A10, E10, K3, K6, K7, K10
	ANTENNA	n/a	Hiberband antenna	A7
System	HOST_RXD	I	Host UART receive	K4
	HOST_TXD	O	Host UART transmit	K5
	WKUPn	I	System wake-up	F1
	RESETn	I	System reset	J10
	IRQn	O	System interrupt request	D10
GNSS	GNSS_EN	O	GNSS module enable	G1
	GNSS_TP	O	GNSS module time pulse	E1
	GNSS_RXD	I	GNSS UART receive	H1
	GNSS_TXD	O	GNSS UART transmit	J1
Debug	DBG_RXD	I	Debug UART receive	K9
	DBG_TXD	O	Debug UART transmit	K8
Reserved	-	n/a	Reserved for internal or future use. Leave unconnected!	C1, C10, D1, F10, G10, H10, K1, K2

Table 1: Hiberband modem pin assignment overview

2 Product specifications

Stressing the Hiberband modem above one or more of the ratings listed in the Absolute Maximum Ratings section may cause permanent damage. These are stress ratings only. Operating the Hiberband modem at these or at any conditions other than those specified in the Operating Conditions sections of the specification should be avoided. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability.



Operating conditions ranges define those limits within which the functionality of the device is guaranteed.

Where application information is given, it is advisory only and does not form part of the specification.

Unless otherwise specified, all operating conditions are valid at an ambient operating temperature of +25 °C.

2.1 Absolute maximum ratings

The absolute maximum ratings of the Hiberband modem given in table 2 apply over the operating temperature range (for reasons of brevity the acronym HB is used for 'Hiberband').

Parameter	Description	Condition	Min	Max	Unit
VCC	Supply voltage	DC voltage at VCC pins	-0.3	4.0	V
WKUP	WKUP input voltage	DC voltage at WKUP pin	-0.3	4.0	V
RESET	RESET input voltage	DC voltage at RESET pin	-0.3	4.0	V
UART	UART input voltages	DC voltage at RXD pins	-0.3	4.0	V
HB antenna power		Input RF power at HB antenna		-8	dBm
HB antenna ruggedness		Output RF load mismatch at HB antenna		20:1	VSWR
$T_{storage}$	Storage temperature		-40	+85	°C

Table 2: Absolute maximum ratings

The Hiberband modem is not protected against overvoltages or reversed voltages. If necessary, voltage spikes exceeding the power supply voltage specification as given in the table above must be limited to values within the specified boundaries by using appropriate protection measures.

2.2 Operating temperature ranges

The following temperature ranges are defined for operation of the Hiberband modem:

- **Normal operating temperature**: the Hiberband modem is fully functional and meets all its product specifications across the specified temperature range.
- **Extended operating temperature**: the Hiberband modem is fully functional but RF performance may be degraded.

The environmental operating ranges of the Hiberband modem are defined in table 3.

Parameter	Description	Min	Typ	Max	Unit
$T_{operating}$	Typical operating temperature		+25		°C
	Normal operating temperature	-30		+70	°C
	Extended operating temperature	-40		+85	°C

Table 3: Environmental conditions

2.3 Maximum ESD ratings

The maximum ESD ratings of the Hiberband modem are specified in table 4.

Parameter	Max	Unit	Remarks
ESD sensitivity for all pins except HB antenna	1000	V	Human Body Model according to JESD22-A114
ESD sensitivity for HB antenna	1000	V	Human Body Model according to JESD22-A114
ESD immunity for HB antenna	4000	V	Contact Discharge according to IEC 61000-4-2
	8000	V	Air Discharge according to IEC 61000-4-2

Table 4: ESD ratings

The Hiberband modem is an Electrostatic Sensitive Device (ESD) and requires appropriate precautions when handling.

2.4 Power supply

The power supply characteristics of the Hiberband modem are specified in table 5.

Parameter	Description	Min	Typ	Max	Unit
VCC	Module supply voltage	3.2	3.3	3.9	V
ICC_{peak}	Module peak current consumption through all VCC pins, during transmit burst at maximum power level, with a matched antenna			1.8	A
	Module peak current consumption through all VCC pins, during transmit burst at maximum power level, with a mismatched antenna			2.2	A

Table 5: Power supply specifications

2.5 Current consumption

The current consumption figures of the Hiberband modem are specified in table 6.

Mode	Condition	Min	Typ	Max	Unit
Hibernation Mode	VCC = 3.3V	0.5	0.7	1.5	µA
Host Communication Mode	VCC = 3.3V	10	20	25	mA
Geo-location Mode	VCC = 3.3V	TBD	TBD	TBD	mA
Hiberband Listen Mode	VCC = 3.3V; max. receive sensitivity	20	23	30	mA
Hiberband Transmission Mode	VCC = 3.3V; VREF = 3.0V; max. receive sensitivity and output power	100	1250	1500	mA

Table 6: Hiberband modem current consumption

When designing the application power supply, attention must be paid to the transient behaviour of the Hiberband modem current consumption when the transmitter power amplifier is turned on. In particular, the Hiberband transmission burst current consumption (figure 2) pattern needs to be taken into account. For comparison purposes, the current consumption for transmission of a continuous wave is shown in figure 3.

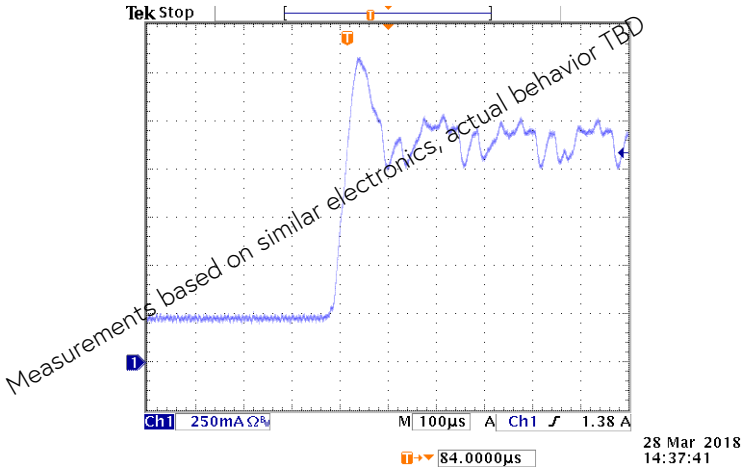


Figure 2: Hiberband transmission burst current consumption

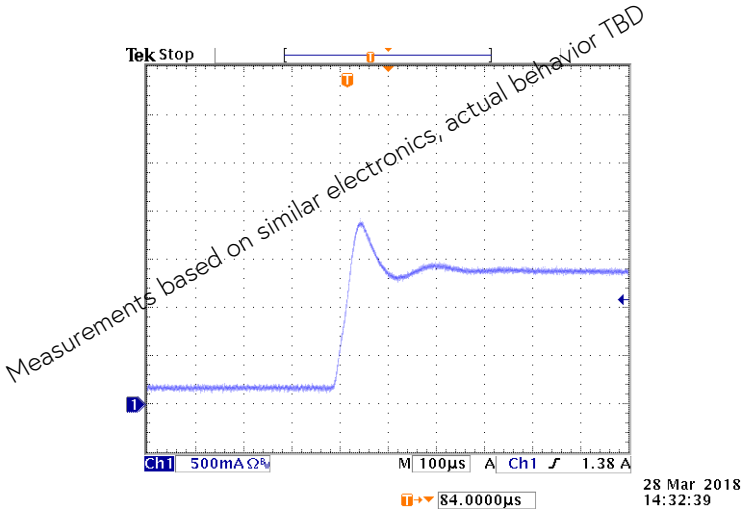


Figure 3: Hiberband modem transmitter current consumption (continuous wave)

Both patterns were measured with the maximum +30 dBm transmission power.

2.6 Dynamic performance

The dynamic performance figures of the Hiberband modem are given in table 7.

Parameter	Description	Min	Typ	Max	Unit
T_{GNSS}	Duration for a GNSS fix	TBD	TBD	TBD	s
T_{listen}	Hiberband listen period	10	80	120	s
$T_{transmit}$	Hiberband transmission burst duration	280	400	500	ms

Table 7: Hiberband modem dynamic performance

2.7 UART communication

The communication parameters of both UARTs of the Hiberband modem are given in table 8.

Parameter	Description	Value	Unit
$UART_{bitrate}$	Default UART bitrate (both UART interfaces)	115.2	kbps
$UART_{SDU}$	Serial data format (databits, parity, stopbits)	8, no parity, 1 stopbit (8N1)	n.a.

Table 8: UART communication parameters

2.8 Hiberband RF communication

The frequency ranges of the Hiberband modem are given in table 9.

Parameter		Min	Max	Unit	Remarks
Hiberband frequency range	Uplink	399.90	400.02	MHz	
	Downlink	400.15	401.00	MHz	Only for Hiberband network management

Table 9: Hiberband modem RF frequency bands

The RF receiver sensitivity figures of the Hiberband modem are given in table 10.

Parameter	Min	Typ	Max	Unit	Remarks
Hiberband receiver sensitivity	TBD	TBD	TBD	dBm	50Ω source

Table 10: Hiberband modem RF receiver sensitivity

The RF transmission output power figures of the Hiberband modem are given in table 11.

Parameter		Min	Max	Unit	Remarks
Hiberband receiver transmit power	Normal	TBD	TBD	dBm	50Ω load
	Boost	20.0	31.7	dBm	50Ω load

Table 11: Hiberband modem RF output power

2.9 Mechanical dimensions

The mechanical drawing of the Hiberband modem is shown in figure 4.

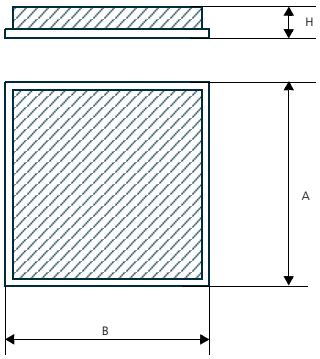


Figure 4: Mechanical drawing Hiberband modem

The pin numbers have been omitted from figure 4. Please refer to section for pin assignment information.

Parameter	Description	Typical	Tolerance
A	Module length	27.0 mm	+0.2/-0.2 mm
B	Module width	27.0 mm	+0.2/-0.2 mm
H	Module height	4.2 mm	+0.3/-0.1 mm

Table 12: Module dimensions

The Hiberband modem an antenna pad for connection of an external antenna.

3 Typical application ciruit

A typical interface between the application host processor, generally a microcontroller, and the Hiberband modem is shown in Figure 5.

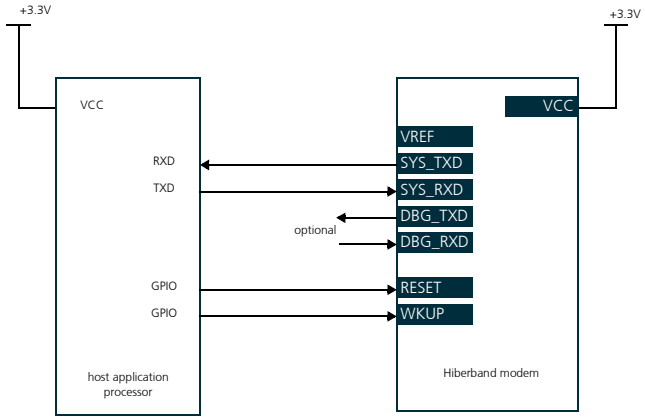


Figure 5: Typical integration of a Hiberband modem with an application host processor

4 Hiberband modem design support

Hiber is strongly committed to providing good support to its partners. In addition to documentation, Hiber offers CAD libraries, reference schematics and board layout footprints, that can be obtained upon request. Please contact us at support@hiber.global for any assistance you may need.

5 Product ordering information

Please find the product ordering information in the table below.

Orderable device	Status	Description
HBR-19MDM001-001	Announced	Hiberband modem, 2nd generation.

Table 13: Hiberband modem product ordering codes

6 Revision history

Date	Revision	Changes
February 12, 2019	1.0	Initial document
March 19, 2019	1.1	Updated notices

Table 14: Document revision history

IMPORTANT NOTICES – PLEASE READ CAREFULLY

FCC Interference Statement, Part 15.105(b): This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Part 15.21 Warning: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Part 15.19(a) Statement: 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."

FCC/ISED RF Exposure Guidance Statement: In order to comply with FCC/ISED RF Exposure requirements, this device must be installed to provide at least 30 cm separation from the human body at all times. Afin de respecter les exigences de la FCC/ISED concernant l'exposition aux fréquences radio, ce système doit être installé pour assurer une séparation d'au moins 30 cm du corps humain à tout instant.

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