

H24 Hardware User Guide

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1.8. Regulatory Requirements

The Federal Communications Commission (FCC) requires application for certification of digital devices in accordance with CFR Title 47, Part 2 and Part 15. This includes MPE calculation. As the H24 modem is not a standalone transceiver but is an integrated module, the H24 cannot be tested by itself for EME certification. It is, however, the integrator's responsibility to have the completed device tested for EME certification.



CAUTION:

Unauthorized repairs or modifications could result in permanent damage to the equipment and void your warranty and your authority to operate this device under Part 15 of the FCC Rules.

1.9. Regulatory Statement (Safety)

The following safety precautions must be observed during all phases of the operation, usage, service or repair of any cellular terminal or mobile incorporating the H24 module. Manufacturers of the cellular terminal are advised to convey the following safety information to users and operating personnel, and to incorporate these guidelines into all manuals supplied with the product. Failure to comply with these precautions violates safety standards of design, manufacture and intended use of the product. Telit assumes no liability for customer failure to comply with these precautions.

- H24 module should not be assembled when voltage is supplied to the 70 pin connector
- H24 module must be operated at the voltages described in the technical documentation
- H24 module must not be mechanically nor electrically changed. Use of connectors should follow the guidance of the technical documentation
- H24 module is designed to meet the EMC requirements of EN 301 489-07
- When integrating the H24 module into a system, Telit recommends testing the system to EN 301 489-07
- You must not remove any label from the H24 module
- Systems using the H24 module are subject to mandatory EMC/RF/Safety (including EME) testing under R&TTE directive 1999/5/EC ([to://www.newapproach.org/Directives/](http://www.newapproach.org/Directives/)). Other directives, such, 2002/95/EC (RoHS), WEEE Directive 2002/96/EC should also apply to a system using the H24 module

1.10. FCC Notice to Users

Telit has not approved any changes or modifications to this device by the user. Any changes or modifications could void the user's authority to operate the equipment. See 47 CFR Sec. 15.21. 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. See 47 CFR Sec. 15.19(3).

If your mobile device or accessory has a USB connector, or is otherwise considered a computer peripheral device whereby it can be connected to a computer for purposes of transferring data, then it is considered a Class B device and the following statement applies:



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 and ICES-003 for Industry Canada. 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 or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment to 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.

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.
- (2) This device must accept any interference received, including interference that may cause undesired operation.

1.11. Precautions

Interface connector and some of the module circuits are not shielded. Be sure to take appropriate precautionary measures in order to avoid ESD while handling the module. ESD can damage the H24 modules. Integrators need to design ESD protection on all external interfaces.

1.12. Antenna and Transmission Safety Precautions

1.12.1. User Operation

Do not operate your unit when a person is within 8 inches (20 centimeters) of the antenna. A person or object within 8 inches (20 centimeters) of the antenna could impair call quality and may cause the phone to operate at a higher power level than necessary.



IMPORTANT:

The unit must be installed in a manner that provides a minimum separation distance of 20 cm or more between the antenna and persons and must not be co-located or operate in conjunction with any other antenna or transmitter to satisfy FCC RF exposure requirements for mobile transmitting devices.

To comply with the FCC RF exposure limits and satisfy the categorical exclusion requirements for mobile transmitters, the requirements described in the following section, [Antenna](#), must be met.



The Products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body; in other applications intended to support or sustain life; for the planning, construction, maintenance, operation or use of any nuclear facility; for the flight, navigation, communication of aircraft or ground support equipment; or in any other application in which the failure of the Product could create a situation where personal injury or death may occur. If CUSTOMER should use any Product or provide any Product to a third party for any such use, CUSTOMER hereby agrees that TELIT is not liable, in whole or in part, for any claims or damages arising from such use, and further agrees to indemnify and hold TELIT harmless from any claim, loss, cost or damage arising from such use.

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2. General Product Description

Designed with Tri bands WCDMA & quad band GSM capabilities, which supports WCDMA bands: B1-2100, B4-1700, B2-1900, B5 -850 & B8-900 with HSPA capability and four GSM bands - 850/900/1800/1900 MHz, with GPRS/EGPRS multi-slot class 12. H24 can operate on any GSM/GPRS/EGPRS/WCDMA/HSPA network to provide voice and data communications.

The H24 is similar to a condensed cellular phone core, which can be integrated into any system or product that needs to transfer voice or data information over a cellular network. Thus, it significantly enhances the system's capabilities, transforming it from a standalone, isolated product to a powerful high-performance system with global communications capabilities.

The H24 is designed as a complete GSM/WCDMA communications solution with all the controls, interfaces and features to support a broad range of applications:

- A powerful audio interface
- A large set of indicators and control signals
- Several advanced power-saving modes
- A variety of serial communications solutions.

All these features and interfaces are easily controlled and configured using a versatile AT command interface that provides full control over the H24 operation.

The H24 control and indication interface extends its capabilities beyond GSM communications. This includes an A/D and GPIO interface, and a regulated output voltage for supplying external circuits. With these interfaces, the H24 can operate and control external applications and receive feedback from external environment and circuits.

The H24 interface design, using a single 70 pin board-to-board connector, through which all application interfaces are managed, facilitates fast and easy integration. It significantly shortens the development process, and minimizes the product's time to market.

The H24 is extremely compact in size with a slim mechanical design, which makes it space saving on the application board and easily fitted into any board design.

The advanced power supply management significantly reduces power consumption to a necessary minimum and prolongs battery life.



Maximum Tx output power:	GSM 850/GSM 900: Power class 4 (33 ± 2 dBm) DCS 1800/PCS 1900: Power class 1 (30 ± 2 dBm) GSM 850/GSM 900: GPRS 4 slot up (28 ± 2 dBm) DCS 1800/PCS 1900: GPRS 4 slot up (25 ± 2 dBm) GSM 850/GSM 900: EGPRS 4 slot up (22 ± 2 dBm) DCS 1800/PCS 1900: EGPRS 4 slot up (21 ± 2 dBm) WCDMA/HSDPA/HSUPA B1, B2, B4, B5, B8: Power class 3 (24 dBm+ 1 /-3 dB)
Interfaces	
Connectors:	Single 70-pin, board-to-board RF MMCX 2 RF UFL Connectors (Diversity , GPS)
SIM Card:	External USIM connectivity 1.8V/3.0 V
Serial Ports:	UART: BR up to 4M bps RS232 supported USB: USB High-Speed device specifications, Rev. 2.0
Data Features	
GPRS:	Multi-slot class 12 (4 Rx/4 Tx/5 Sum) Max air Downlink BR 80 kbps Coding scheme CS1-CS4 Class B
EGPRS (model dependant):	Multi-slot class 12 Max air Downlink BR 236 kbps Coding scheme MCS1-MCS9 Class B
CSD:	Max BR 14.4 kbps
SMS:	MO/MT Text and PDU modes Cell broadcast
Voice Features	
Telephony	
Digital audio	H24 PCM bus can be set also as Slave or Continues mode. Clock: 2048 kHz, frame sync clock: 8 kHz .



3. Hardware Interface Description

The following paragraphs describe in details the hardware requirements for properly interfacing and operating the H24 module.

3.1. Architecture Overview

H24 Block Diagram below illustrates the primary functional components of the H24.

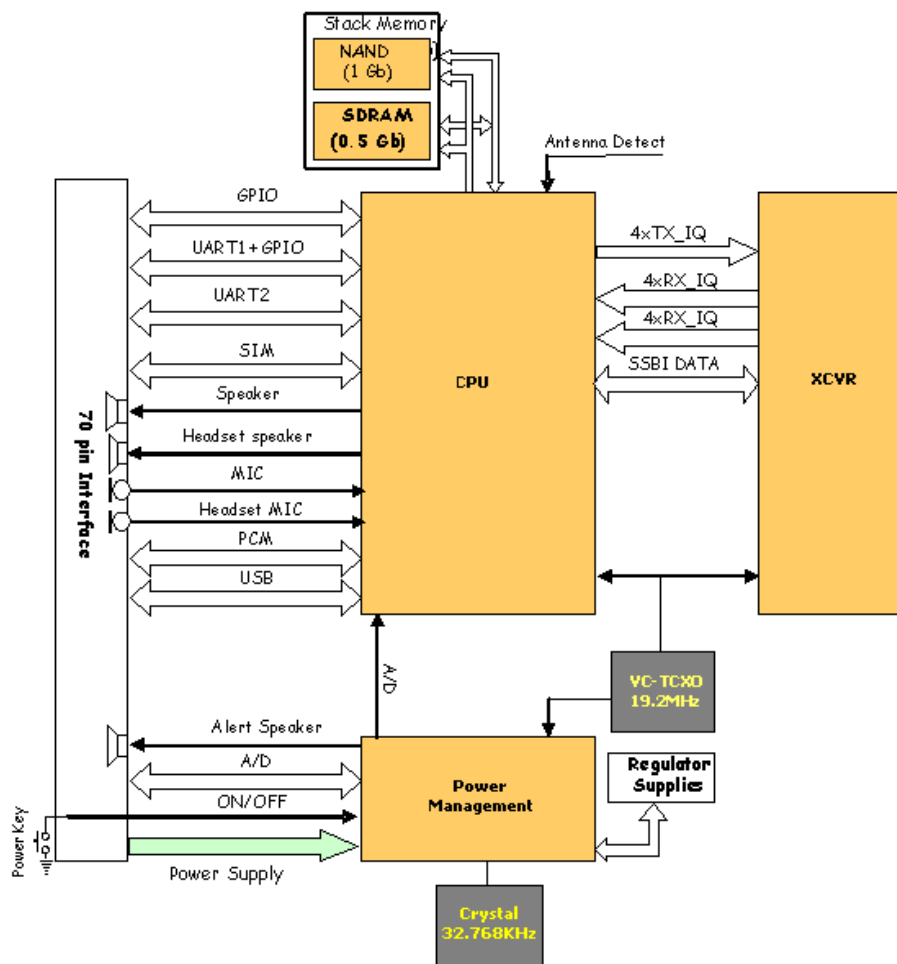


Figure 3-1: H24 block diagram



The H24 consists of the following blocks:

3.1.1. Digital Block

- Micro-controller Unit (MCU) for system and user code execution.
- Digital Signal Processor (DSP) for voice and data processing.
- Serial communications interfaces.
 - USB driver interface
 - UART1
 - UART2
 - I2C
 - SIM card
- Digital audio (PCM) bus interface.
- General purpose IO signals.

3.1.2. Analog Block

- Power Management IC (PMIC).
 - Internal regulators
 - 1 external regulator for customer use
- Analog audio interface management.
 - Speaker, microphone
 - Alert speaker
 - Headset
- General purpose and dedicated A/D signals.
 - A/D
 - Voltage sensor
 - Temperature sensor
- Real Time Clock (RTC) subsystem.

3.1.3. RF Transceiver Block

The following figures give a detailed RF block diagram.



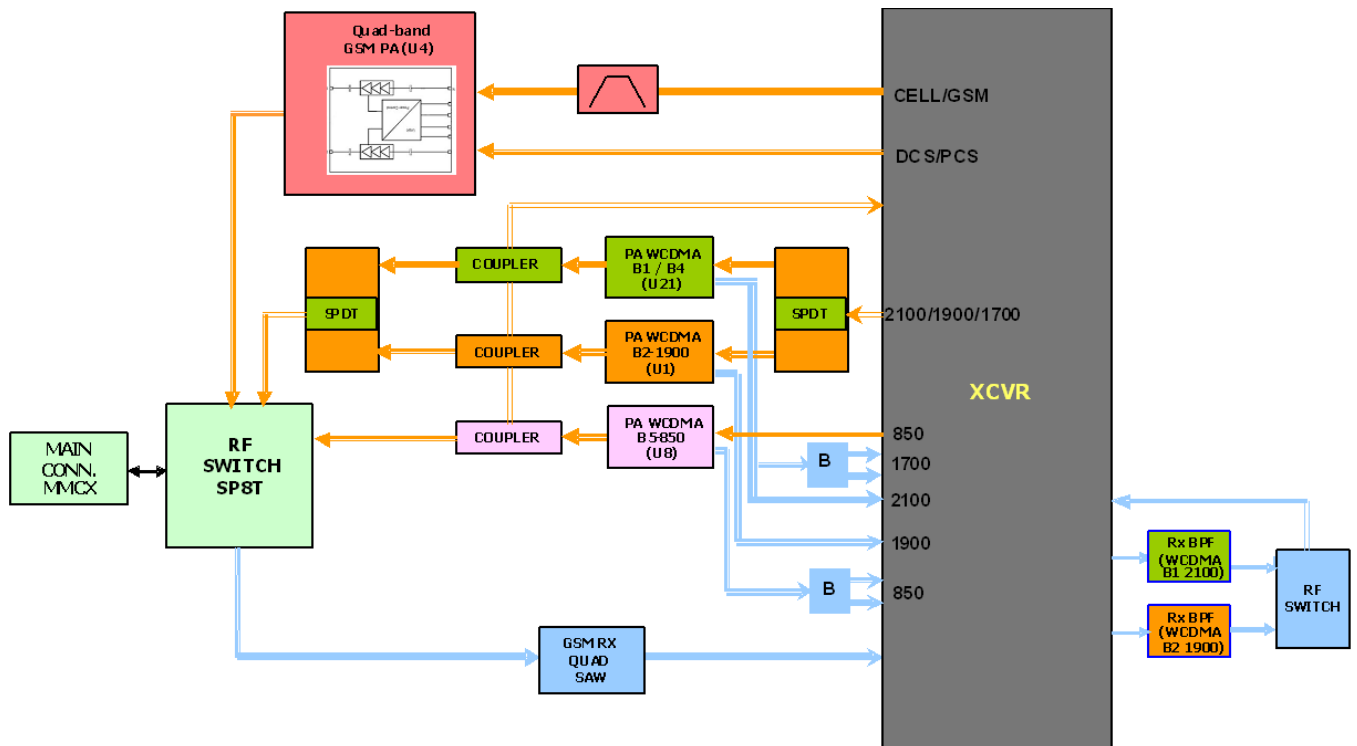


Figure 3-2: GSM and WCDMA Main Connector Block Diagram

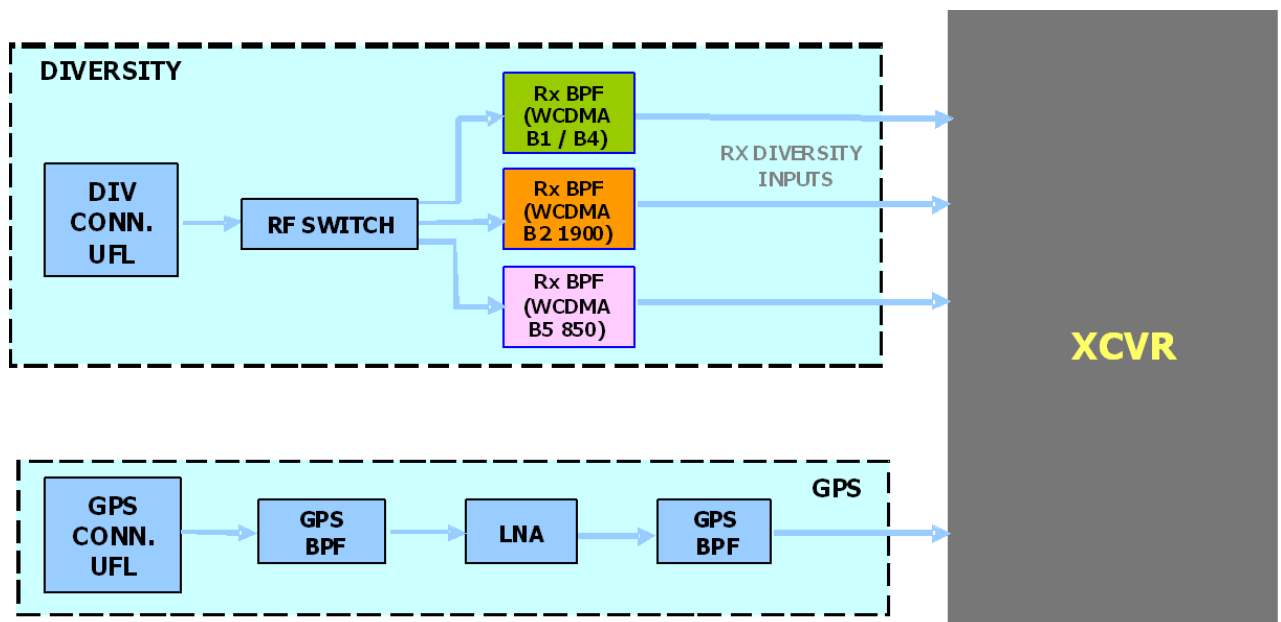


Figure 3-3: WCDMA Diversity Circuitry Block Diagram

3.1.4. WCDMA Transceiver

- Transceiver includes: modulator, receiver, LNAs, Mixers, VCOs, I/Q outputs and buffers for all WCDMA bands.



- Three RF Power Amplifiers for B1-2100 or B4-1700, B2-1900 & B5 - 850 or B8 - 900.
- Three couplers for feedback into the Modulator for each band.
- RF Switch SP9T for selecting corrected path to and from main MMCX connector.
- Receive path is inside PA via internal duplexer into the Transceiver.
- Internal LNAs for all WCDMA bands inside Transceiver
- External switch, RF SPDT, from WB1900 & WB2100 LNA's output into one receiver's differential input.
- Diversity path: From Diversity UFL connector via SP3T into SAW filter for
- W2100/W1700, W1900 & W850/W900 fed into secondary receivers inputs inside the Transceiver.

3.2. Operating Modes

H24 incorporates several operating modes. Each operating mode is different in the active features and interfaces.

The following table summarizes the general characteristics of the H24 operating modes and provides general guidelines for operation.

Mode	Description	Features
Not Powered	VCC supply is disconnected.	The H24 is Off. Any signals connected to the interface connector must be set low or tri-state.
Off Mode	Valid VCC supply. RESET_N signal is enabled (low).	The H24 Interfaces are Off. Only the internal RTC timer is operating. Any signals connected to the interface connector must be set low or tri-stated.
Idle Mode	RESET_N signal is disabled (high). CTS_N and DSR_N signals are enabled (low).	The H24 is fully active, registered to the GSM network and ready to communicate. This is the default power-up mode.
Sleep Mode	RESET_N signal is high. CTS_N signal is disabled.	The H24 is in low power mode. The application interfaces are disabled, but, H24 continues to monitor the GSM network.
CSD call or GPRS/EGPRS data	RESET_N signal is high. TXEN_N signal is toggling.	A GSM voice or data call is in progress. When the call terminates, H24 returns to the last operating state (Idle or Sleep).
CSD call or WCDMA/HSPA data	RESET_N signal is high. TXEN_N signal is toggling.	A GSM voice or data call is in progress. When the call terminates, H24 returns to the last operating state (Idle or Sleep).





NOTE:

For +MCONN=2, CTS_N is not active (disabled).

3.3. Power Supply

The H24 power supply must be a single external DC voltage source of 3.3V to 4.2V. The power supply must be able to sustain the voltage level during a GSM transmit burst current surge, which may reach 2.0A.

The H24 interface connector has 8 contacts for the main power supply, as described in the following table. All these contacts must be used for proper operation.

Pin #	Signal Name	Description
1-4	GND	Main ground connection for H24 module.
5-8	VCC	DC supply input for H24 module. $V_{IN} = 3.3 \text{ V to } 4.2 \text{ V}$ $I_{MAX} = 2 \text{ A during transmit bursts}$ Maximum rise time: 8mS AC ripple: +/-3%

Table 3-1: Power Supply Signals



IMPORTANT:

Do not operate the H24 out of its electrical or environmental limits. Refer to the specifications chapter for details of these limits.

The H24 does not incorporate a hard reset capability. The user should implement a power removal mechanism for hard resetting the unit when needed. This action will be performed with care as it could cause damage to the H24.

3.4. Power Supply Design

Special care must be taken when designing the power supply of the H24. The single external DC power source indirectly supplies all the digital and analog interfaces, but also directly supplies the RF power amplifier (PA). Therefore, any degradation in the power supply performance, due to losses, noises or transients, will directly affect the H24 performance.

The burst-mode operation of the GSM transmission and reception draws instantaneous current surges from the power supply, which causes temporary voltage drops of the power supply level. The transmission bursts consume the most instantaneous current, and therefore cause the largest voltage drop. If the voltage drops are not minimized, the frequent voltage fluctuations may degrade the H24 performance.

The following illustrates the power supply behavior during GSM transmission.



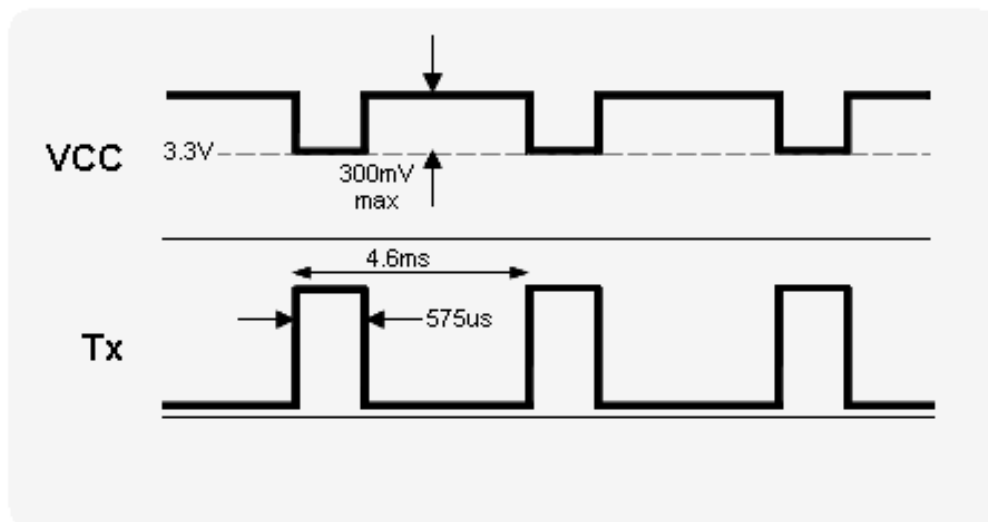


Figure 3-4: Transmission Power Drops



NOTE:

1 TX slot is shown.

It is recommended that the voltage drops during a transmit burst will not exceed 300mV, measured on the H24 interface connector. In any case, the H24 supply input must not drop below the minimum operating level during a transmit burst. Dropping below the minimum operating level may result in a low voltage detection, which will initiate an automatic power-off.

To minimize the losses and transients on the power supply lines, it is recommended to follow these guidelines:

- Use a 1000 uF, or greater, low ESR capacitor on the H24 supply inputs. The capacitor should be located as near to the H24 interface connector as possible.
- Use low impedance power source, cabling and board routing.
- Use cabling and routing as short as possible.
- Filter the H24 supply lines using filtering capacitors, as described in the following table.

Capacitor	Usage	Description
1000 uF	GSM Transmit current surge	Minimizes power supply losses during transmit bursts- no more than 200mV. Use maximum possible value.



10 nF, 100 nF	Digital switching noise	Filters digital logic noises from clocks and data sources.
8.2 pF, 10 pF	1800/1900/2100/1700 MHz bands	Filters transmission EMI.
33 pF, 39 pF	850/900 MHz bands	Filters transmission EMI.

Table 3-2: Recommended power supply filtering

3.5. Current Consumption

The table below specifies typical H24 current consumption ratings in various operating modes. The current ratings refer to the overall H24 current consumption over the VCC supply.



NOTE:

H24 was tested at 25°C, voltage level was 4V.
Idle mode measurements were taken without USB cable connected.

Parameter	Description	Conditions		Min	Typ	Max	Unit
I_{OFF}	RTC mode				40	50	µA
I_{IDLE}	Idle mode				22		mA
I_{SLEEP}	Low power mode	DRx	2		2.95		mA
			5		1.82		
		UART only	9		<1.5		
I_{GSM-RMS}	GSM voice - 1 TX slot	GSM850 PCL	5		367		mA
			10		214		
			15		165		
			19		151		
		EGSM900 PCL	5		337		
			10		206		
			15		162		
			19		151		



Parameter	Description	Conditions		Min	Typ	Max	Unit
$I_{GSM-MAX}$	Peak current During TX slot	GSM850 PCL	5		1837		mA
			10		853		
			15		438		
			19		331		
		GSM900 PCL	5	1667			
			10	886			
			15	459			
			19	335			
		DCS1800 PCL	0	1126			
			5	562			
			10	373			
			15	315			
		PCS1900 PCL	0	1302			
			5	637			
			10	400			
			15	327			
$I_{WCDMA-RMS}$	WCDMA	WCDMA850	24dBm		565		mA
			0dBm		219		
			-24dBm		215		
			-50dBm		214		
		WCDMA1900	24dBm	660			
			0dBm	195			
			-24dBm	184			
			-50dBm	182			
		WCDMA2100	24dBm	608			
			0dBm	217			
			-24dBm	211			
			-50dBm	209			
		WCDMA1700	24dBm	630			
			0dBm	252			
			-24dBm	248			
			-50dBm	246			
		WCDMA900	24dBm	611			
			0dBm	243			
			-24dBm	219			
			-50dBm	217			

Table 3-3: H24 current ratings



3.6. Power On/Off Operation

The H24 power on and off process includes two primary phases, which are indicated at the interface connector by the hardware output signals RESET_N and CTS_N.

The RESET_N signal indicates whether H24 is powered on or off.

When this signal is enabled (low), H24 is powered-off. When it is disabled (high), H24 is powered-on.

The CTS_N signal complies with RS-232 standard. When this signal is high, the H24 serial interface is disabled. When it is low, the serial interface is enabled, and H24 is ready to communicate.



IMPORTANT:

The timing shown in the diagrams below depends on network response time.

3.6.1. Turning the H24 On

When the H24 power supply is stable above the minimum operating level and H24 is powered off, only the internal RTC timer is active.

When H24 is turned on, by any of the methods described below, it will first perform an automatic internal system-test, during which basic functions are verified. The system-test duration is typically 3 seconds (Depends on network coverage). When the system-test has completed H24 resumes normal operation.

During the internal system-test process H24 may toggle several interface signals, which are visible to the application. These signals do not represent any valid state or data, and should be ignored by the customer application until the system-test has completed.

3.6.2. Power Supply Turn-on

When the H24 is powered for the first time, it will switch on only in case that a valid reason was detected (IGN, ON_N activation), otherwise it will stay off.

The ON_N and IGN signals will be active and responding only after the power supply to the H24 is stable above the minimum operating level. Therefore, the ON_N and IGN signals must not be used for at least 100 milliseconds after applying power to H24.



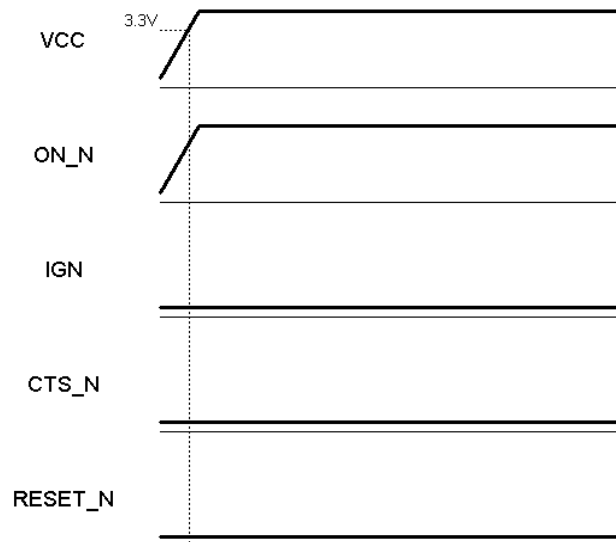


Figure 3-5: Power supply turn on

3.6.3. Turning the H24 On Using ON_N

The ON_N input signal is set high by an internal pull-up resistor whenever a power supply is applied to H24. Therefore, it is recommended to operate this signal using an open collector/drain circuit connection.

Asserting the ON_N signal low for a minimum of 500 milliseconds (0.5 seconds) and a maximum of 1.5 seconds will cause the H24 to turn-on.

Asserting the ON_N signal low for more than 1.5 seconds may cause the H24 to interpret the signal as a power-off command, and turn off immediately after turning on.

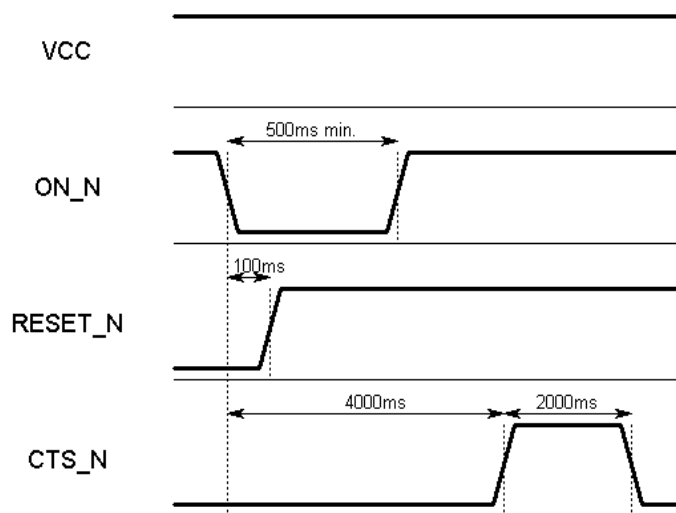


Figure 2-6: Figure 3-6: Turning the H24 On Using ON_N



3.6.4. Turning the H24 On Using IGN

The IGN input signal must be set low when not used. To turn on H24, this signal must be asserted high for at least 8 seconds. The IGN signal must remain high for the duration of the H24 operation. H24 powers down when the IGN signal is returned to its low state.

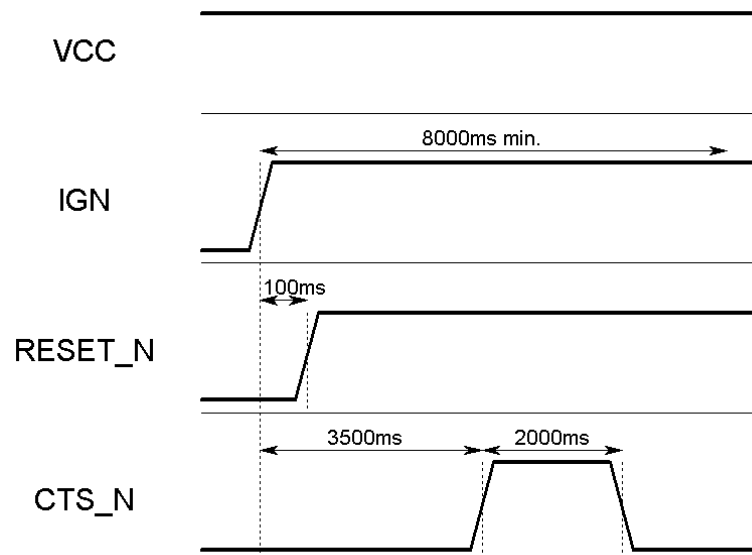


Figure 3-7: Turning the H24 On Using IGN

3.6.5. Turning the H24 Off

There are several ways to turn the H24 off:

- Asserting the ON_N signal low for a minimum of 2 seconds.
- Setting the IGN signal low.
- Low power automatic shut down.
- AT command.
- Voltage exceeds 4.5V.
- Temperature at PMIC exceeds 125°C.

3.6.6. Turning the H24 off Using ON_N

The ON_N signal is set high using an internal pull up resistor when power is applied to H24. Asserting the ON_N signal low for a minimum of 2 seconds will turn H24 off. This will initiate a normal power-off process, which includes disabling of all applications interfaces (SIM card, audio, etc.) and closing the network connection.



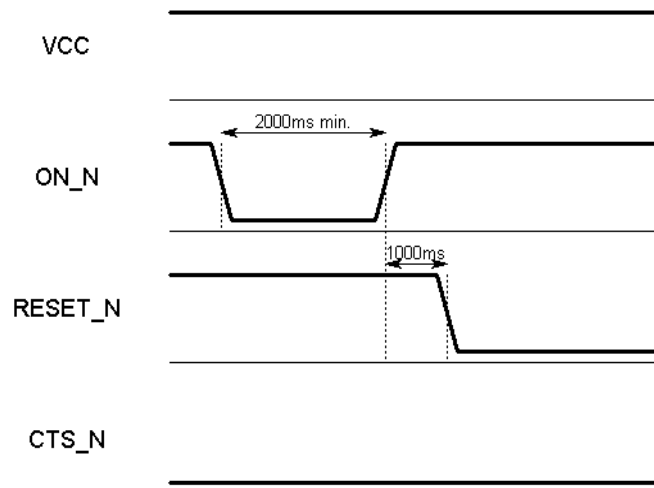


Figure 3-8: Turning the H24 Off Using ON_N

3.6.7. Turning the H24 off Using IGN

The IGN signal may be used to power off H24 only if it was also used to power it on. When the IGN signal is set low, H24 will turn off. This will initiate a normal power-off process, which includes disabling of all applications interfaces (SIM card, audio, etc.) and closing the network connection.

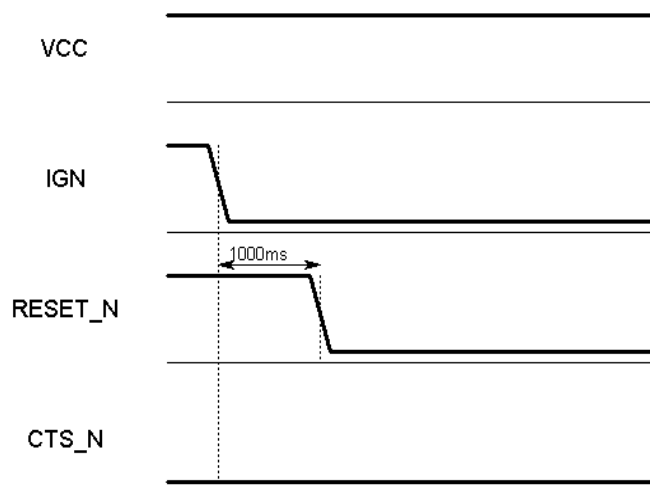


Figure 3-9: Turning the H24 Off Using IGN

3.6.8. Power Loss shut down

A low power shut down occurs when H24 senses the external power supply is below the minimal operating limit. The module will respond by powering down automatically without notice.



This form of power-down is not recommended for regular use since the unexpected power loss may result in loss of data.

3.6.9. Turning the H24 off Using AT+MPWRDN

The AT+MPWRDN command initiates a H24 power down (even if the H24 was powered on by IGN). This command emulates the ON_N signal operation for power off.

3.7. Low Power Mode

The H24 incorporates an optional low power mode, called Sleep Mode, in which it operates in minimum functionality, and therefore draws significantly less current. During low power mode the H24 network connection is not lost. H24 continues to monitor the GSM network constantly for any incoming calls or data.

During low power mode, most of the H24 interface signals are inactive and are kept in their previous state, prior to activating low power mode. To save power, the H24 internal Main clock and some of its circuits are shut down, and therefore serial communications is limited.

3.7.1. Activating Low Power Mode

UART:

By default, the H24 powers on in Idle mode. In this mode the H24 interfaces and features are functional and the module is fully active.

Low power mode is controlled by the AT+MSLEEP & ATS24 commands.

The command AT+MSLEEP=1 enable Sleep Mode (AT+MSLEEP=0 disable Sleep Mode).

The value of S24 command determines the inactive state duration required by H24, in seconds, after which H24 will enter sleep mode.

For example:

ATS24 = 1 activates low power mode after 1 second of UART inactivity.

ATS24 = 5 activates low power mode after 5 seconds of UART inactivity.



NOTE:

ATS24=0 will not disable sleep mode at H24.

AT+MSLEEP = 1 Enable low power mode.

AT+MSLEEP = 0 Disable low power mode (default).



IMPORTANT:

H24 will not enter low power mode in any case when there is data present on the serial interface. Also when any network (GSM/UMTS) activity (e.g. incoming voice call, data session) or an internal system task is running. Only when processing of any external or internal system task has completed, if AT+MSLEEP=1 and H24 UART is inactive for the duration of ATS24, H24 will enter low power mode.



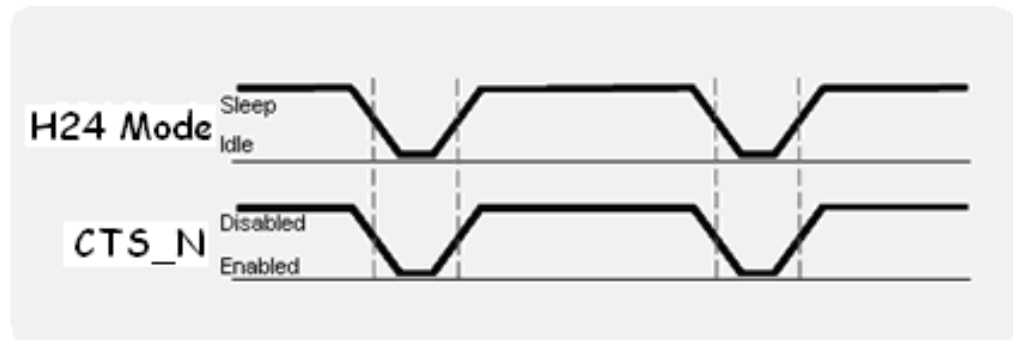


Figure 3-10: CTS Signal During Sleep Mode

CTS Signal During Sleep Mode

The periodical enabling and disabling of the CTS_N signal during low power mode can be controlled by the AT+MSCTS command.

Setting AT+MSCTS=0 permanently disables the serial interface during low power mode, even during a network page by H24. The CTS_N signal is disabled, and therefore the serial interfaces are blocked.

3.7.3. Terminating Low Power Mode

Terminating the low power mode, or wake-up, is defined as the transition of the H24 operating state from Sleep mode to Idle mode. There are several ways (using UART CTS_N signal, WKUPI_N line or UART RX line interrupt) to wake-up H24 from low power mode as described below.



IMPORTANT:

During power saving mode the H24 internal clocks and circuits are disabled, in order to minimize power consumption. When terminating the power saving mode, and switching to Idle mode, H24 requires a minimal delay time to reactivate and stabilize its internal circuits before it can respond to application data.

This delay is typically of 100 milliseconds, and is also indicated by the CTS_N signal inactive (high) state. The delay guarantees that data on the serial interface is not lost or misinterpreted.

3.7.4. Temporary Termination of Low Power Mode

The WKUPI_N signal is an active low input that is set high by default. By asserting this signal low the application can wake-up H24 from low power mode and switch to idle mode.

Low power mode may be terminated temporarily by several sources, some of which are user initiated and others are initiated by the system.

3.7.4.1. Using the WKUPI_N signal to wake UART from Sleep Mode

The WKUPI_N signal is an active low input, which is set high by default. By asserting this signal low the application can wake-up H24 from low power mode and switch to Idle mode.



H24 will remain in idle mode, awake and fully active, as long as WKUPI_N signal remains low. When this signal is disabled and set high again, H24 will return to Sleep mode automatically, according to the ATS24 settings.

The WKUPI_N signal is the **recommended** method to temporarily wake-up H24 from low power mode. It provides the application full control of the H24 operating mode and guarantees that data on the serial interface will not be lost or misinterpreted.

The WKUPI_N signal can be used to wake up H24 from low power mode. If the serial interface has been controlled by the AT+IFC=1,1 (or AT&K4) command, the application can work in Hardware Flow Control accumulate the data in its buffer and send it to the module when the CTS is Enabled. (Note: this method of operation works without using AT+MSCTS=0 command).

3.7.4.2. Incoming Network Data

During low power mode, H24 continues monitoring the network (GSM or UMTS) for any incoming data, message or voice calls.

When H24 receives an indication from the network that an incoming voice call, message or data is available, it automatically wakes up from low power mode to alert the application. When H24 has completed to process all the tasks related to the incoming data, it will automatically return to low power mode according to the ATS24 settings.

Depending on the type of network indication and the application settings, H24 may operate in several methods, which are configurable by AT commands, to alert the application of the incoming data:

- Enable the WKUPO_N signal to wake-up the application from low power by setting ATS100 to value bigger than zero. ATS102 can be 0 but is 30ms by default for example ATS102=30 will start WKUPO_N signal 30 millisecond before data send out from UART to Host.
- Send data to the application over the serial interface.
- Enable the serial interface's Ring Indicator (RI_N) signal.

3.7.4.3. Data on the Serial interface

While H24 is temporarily awake in Idle mode, data may be transmitted on the serial interface. In case data is being transmitted in any direction, H24 will not return to low power mode. This is regardless of the original wake-up reason or source. H24 will remain awake while data is transferred.

Only when the serial interface transfer is completed and the data has been processed, H24 will return to low power mode automatically, according to the ATS24 settings (see the following figure).



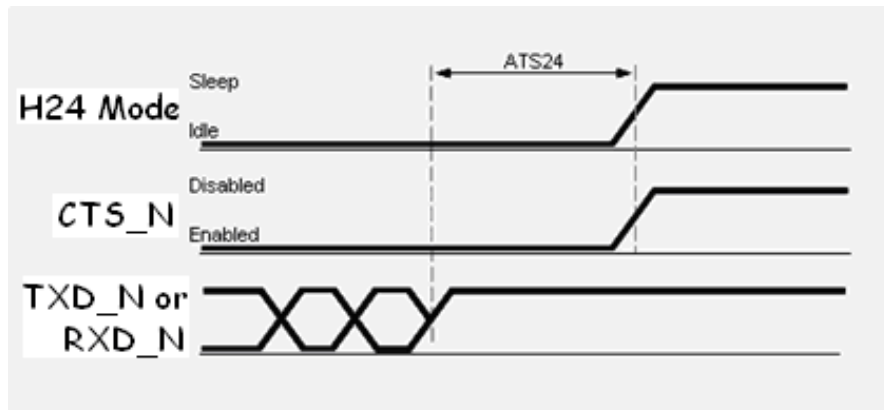


Figure 3-11: Serial Interface Data

3.7.5. UART and USB Exiting of Low Power Mode

3.7.5.1. Enable/Disable Low Power Mode

The H24 low power mode is enabled and disabled by the AT+MSLEEP command.

To permanently terminate the H24 low power mode, the +MSLEEP=0 command must be used. H24 will not return to low power mode until an AT+MSLEEP=1 command is set again.

This command can be sent only when the serial interface is active.

3.7.5.2. UART Exiting of Low Power Mode

In case the serial interface is disabled, Hardware Flow control is OFF and WKUP_I is not used, it must first be activated before sending this command. To reactivate the serial interface, a temporary termination of the low power mode is required; by sending AT command that will catch by the RX line interrupt service routine and will use to wake up the module (The execution of the first command after exit Sleep Mode by RX interrupt is not guaranteed).

3.7.5.3. USB Exiting of Low Power Mode

Handled by suspend/resume mechanism.

3.8. Real Time Clock

H24 incorporates a Real Time Clock (RTC) mechanism that performs time keeping. The RTC subsystem is embedded in the PMIC and operates in all of the H24 operating modes (Off, Idle, Sleep), as long as power is supplied above the minimum operating level.

The H24 time and date can be set using the following methods:

- Automatically retrieved from the GSM network.
In case H24 is operated in a GSM network that supports automatic time zone updating, it will update the RTC with the local time and date upon connection to the network. The RTC will continue to keep the time from that point.



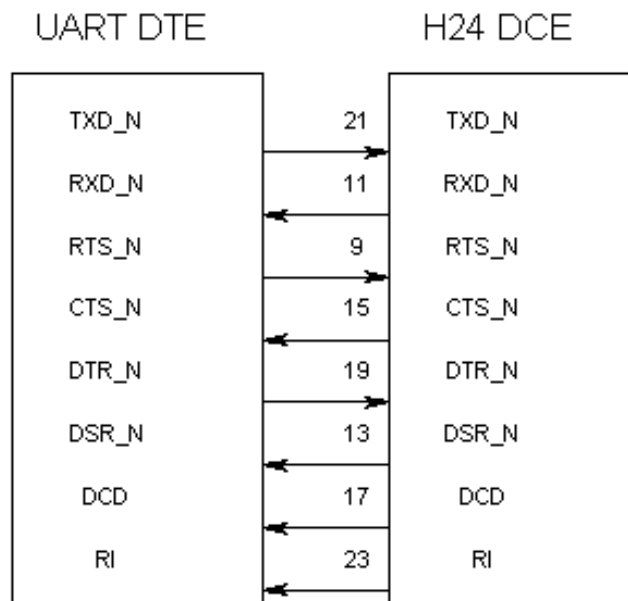


Figure 3-12: UART1 Interface Signals

UART1 Interface Signals

The H24 primary UART supports maximum data rate of up to 4 Mbps interface and up to 230 kbps for data services using the UART1 interface.

All flow control handshakes are supported: hardware, software, or none.

Parity bit and Stop bit definitions are also supported.

The UART default port configuration is 8 data bits, 1 stop bit and no parity, with hardware flow control.

3.9.2. Secondary UART (UART2)

The H24 secondary UART is a standard 4-signal bus, and it is used for GPS only.

For more information contact TTSC.



WARNING:

The secondary UART can't be used for standard communication (such as AT commands etc.) Do not connect UART2 signals when GPS is not used.



3.9.3. USB Interface

H24 incorporates a standard Universal Serial Bus (USB) interface.

The H24 USB electrical interface and protocol conform to the USB 2.0 high-speed specifications. H24 is defined as a USB device on the USB bus and does not support hub or host functionality.

USB may be used for standard communications with H24, as done through the UART interface.

The USB interface signals are shown in the following figure.

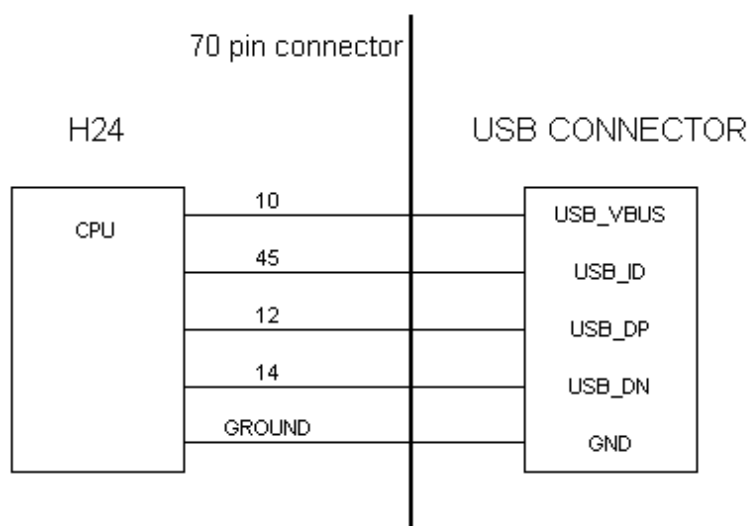


Figure 3-13: USB Interface Signals

USB Interface Signals

UID determines the USB mode configuration: Host or Client (Client mode is supported).



NOTE:

Do not connect USB_ID pin (pin 45).



IMPORTANT:

When laying out USB signals: Run HS_D_P/M as diff pair with equal length, to maintain a nominal 90 Ω differential impedance +/-15%, single-ended impedance in a range of 42 to 78 Ω being acceptable.

3.10. SIM Interface

The H24 incorporates a SIM interface, which conforms to the GSM 11.11 and GSM 11.12 standards, which are based on the ISO/IEC 7816 standard. These standards define the electrical, signaling and protocol specifications of a GSM SIM card.



H24 does not incorporate an on-board SIM card tray for SIM placement. The SIM must be located on the user application board, external to the H24. The H24 SIM interface includes all the necessary signals, which are routed to the interface connector, for a direct and complete connection to an external SIM.

H24 supports dynamic detection of the SIM card, through a dedicated SIM detection signal. H24 will detect a SIM card insertion or removal upon power up or during operation by the transitions on the SIM_PD_N signal.

Some of the H24 models incorporate eSIM (embedded SIM). Refer to Embedded SIM.

3.11. External SIM Connection

The following table details the SIM interface signals.

Connected to 70 pin	H24	Interruptible
44	SIM_RST_N	N
46	SIM_CLK	N
48	SIM_VCC	N
50	SIM_PD_N	Y
52	SIM_DIO	N

Table 3-4: SIM Interface Signals

3.11.1. SIM Design Guidelines

The SIM interface and signals design is extremely important for proper operation of H24 and the SIM card. There are several design guidelines that must be followed to achieve a robust and stable design that meets the required standards and regulations.

- Using the SIM detection signal, SIM_PD_N, is mandatory in case the SIM card is accessible to the user and may be removed during H24 operation. To avoid any damage to the SIM or H24, the SIM interface signals must be deactivated before the SIM card contacts are mechanically removed from the SIM tray contacts. Therefore, the SIM_PD_N detection signal must be disabled before the SIM is removed from its tray.
- The SIM should be located, and its signals should be routed, away from any possible EMI sources, such as the RF antenna and digital switching signals.
- The SIM interface signals length should not exceed 100 mm between the H24 interface connector and the SIM tray. This is to meet with EMC regulations and improve signal integrity.



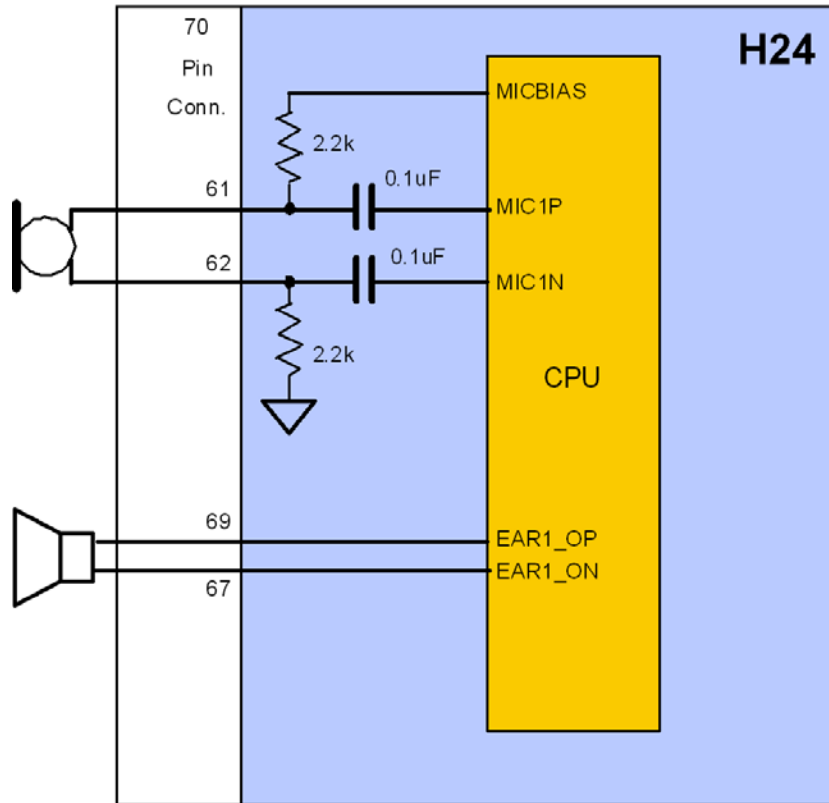


Figure 3-15: Handset Interface

3.14. Headset Interface

The most basic headset configuration is shown in figure 4-16. This configuration uses an AC-coupled mono earphone interface and a standard single-ended microphone interface.

The output power for the single-ended HPH_L/HPH_R output is typically 21.6 mW per side for a full-scale +3 dBm₀ sine wave into a 15Ω speaker.

Few alternative earphone configurations are given in the following paragraphs. If the load capacitance is greater than 100 pF due to earphones with different capacitive load used, a RC shunt network (0.22μF and 22Ω) is recommended to prevent oscillations as shown in figure 4-16.



NOTE:

In case a differential mic is used, the negative node should be connected to pin 70.



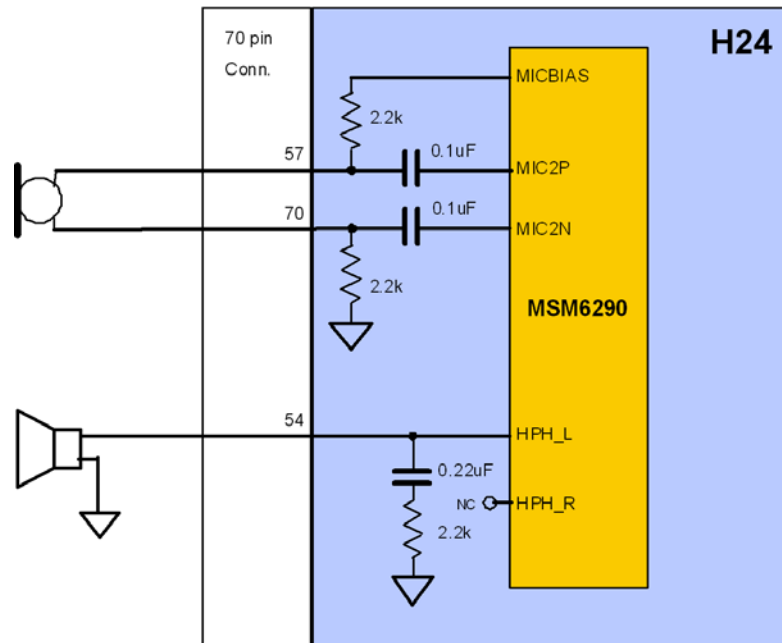


Figure 3-16: Headset Interface

3.15. Interface to an External Speaker Amplifier

The power management device can also be used as a speaker amplifier. The power management speaker driver output power is rated at 500 mW and can be adjust up to 1W. To use this feature as an amplifier of an audio output, be sure to set the appropriate speaker driver analog and digital gains, and set the analog high-pass filter corner at the resonant frequency of the far-field speaker transducer (see figure 4-17).

For gain levels, please refer to H24 AT Reference Commands manual.

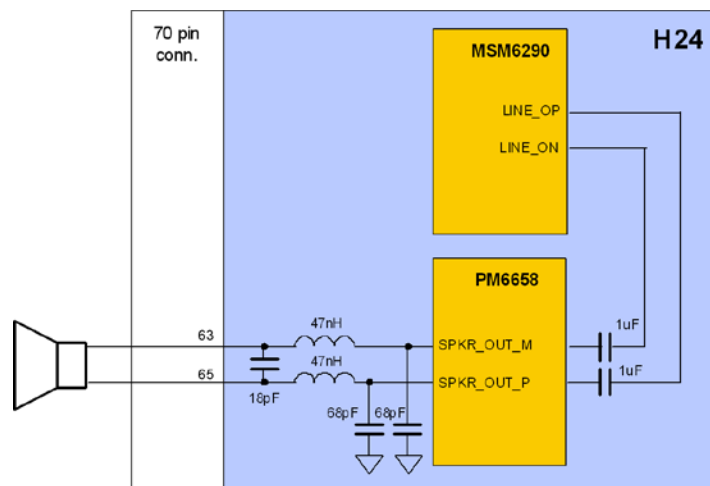


Figure 3-17: External Speaker



3.16. Audio Design

The audio quality delivered by H24 is highly affected by the application audio design, particularly when using the analog audio interface. Therefore, special care must be taken when designing the H24 audio interface. Improper design and implementation of the audio interface will result in poor audio quality.

Poor audio quality is a result of electrical interferences, or noises, from circuits surrounding the audio interface. There are several possible sources for the audio noise:

- Transients and losses on the power supply
- EMI from antenna radiations
- Digital logic switching noise

Most of the audio noise originates from the GSM transmit burst current surges (217 Hz TDMA buzz), which appear on the main power supply lines and antenna, but also indirectly penetrate the internal application's supplies and signals. The noises are transferred into the H24's audio circuits through the microphone input signals and then are amplified by the H24's internal audio amplifiers.

To minimize the audio noise and improve the audio performance the microphone and speaker signals must be designed with sufficient protection from surrounding noises.

The following guidelines should be followed to achieve best audio performance:

- Reference the microphone input circuits to the H24 AGND interface signal.
- If using single-ended audio outputs, they should be referenced to the H24 AGND interface signal.
- Keep the audio circuits away from the antenna.
- Use RF filtering capacitors on the audio signals, as described in table 4-2. The audio signals should not be routed adjacent to digital signals.
- Isolate the audio signals by a surrounding ground plane or shields.
- **Filter** internal supplies and signals that may indirectly affect the audio circuits, from noises and voltage drops.

3.16.1. Analog Ground

The H24 interface incorporates a dedicated analog ground contact, AGND pin 59, which is internally connected to the H24's ground. The AGND signal is intended to provide a separate ground connection for the application's external audio devices and circuits.

This signal provides an isolated ground connection directly from H24, which is separated from the noisy digital ground of the application. It is recommended to connect this signal to analog audio devices and circuits used by the application. Using a separate analog ground minimizes audio noises and improves the audio circuit's immunity from external interferences.

3.16.2. Digital Audio Interface

The H24 digital audio interface is a serial Pulse Code Modulation (PCM) bus, which uses linear 2's complement coding. H24 is the PCM bus master, supplying the clock and sync signals to the application.



The H24 digital interface is a 4 signal PCM bus, which includes a bit clock output signal for the bus timing, a frame sync output signal for audio sampling timing, and serial data input and output signals.



IMPORTANT:

The PCM bus signals are shared internally by the analog audio interface and the digital audio interface. Therefore, when using the analog audio interface the PCM bus signals must be tri-stated or disconnected at the interface connector.

The digital audio interface supports 4 types of audio data formats, which define the PCM bus configuration and data rates:

- Voice band audio - Intended for speech during voice calls and for mono rings and alerts.
- Stereo audio - Includes 3 audio formats that support high quality stereo ring tones and alerts.

3.16.3. Voice band Audio

This digital voice audio format is used for speech during voice calls and for mono rings and alerts.

The PCM bus signal's configuration for voiceband audio is:

- PCM_CLK - 2048 kHz serial clock
- PCM_FS - 8 kHz bit-wide frame-sync
- PCM_DOUT - 13-bit linear audio data output
- PCM_DIN - 13-bit linear audio data input

The analog audio is sampled at an 8 kHz rate and converted to linear 13-bit serial PCM audio data. The serial data is transferred on the PCM bus in 16-bit word format, which includes 13 sampled data bits, and 3 added zero value bits.

The 16-bit serial data is transferred in both directions after each sync signal's falling edge. The sync signal pulse duration is one clock period, after which the serial data is transferred in both directions for 16 consecutive clock periods.

Following the 16-bit data transfer, the serial input and output data signals inactivate until the next sync pulse, which occurs every 125 μS (8 kHz). It is recommended the serial data signals will be High-Z during the inactive period.



IMPORTANT:

In digital audio mode the input and output gains cannot be controlled by AT commands.

Figure 4-18 illustrates the PCM bus format of the voiceband audio configuration.



4. Controls and Indicators Interface

The H24 incorporates several interface signals for controlling and monitoring the module's operation. The following paragraphs describe these signals and their operation.

The following table gives a description of the controls and indicators signals.

Connector Pin	Signal Name	Description
25	RESET_N	H24 system reset output indicator. When high, H24 is operating.
27	VREF	2.6V regulated output. Supplies external circuits up to 300mA.
16	WKUPO_N	Host application wake-up signal indicator.
49	Network status indicator	Network status indicator. (GPRS/GSM/WCDMA)
39	TXEN_N	Transmission burst indication.
28, 30, 32, 34, 36, 38, 40, 42	GPIO 1-8	General purpose IO signals for customer use.

Table 4-1: Controls and indicators

4.1. Reset

The RESET_N output signal indicates the H24's operating status. This signal is set high after power up, when H24 is operating. It is set low when H24 is powered off.

When the RESET_N signal is low, the H24 interface signals are disabled and do not represent any valid data or state. Furthermore, any input signals connected to the H24 interface must be disabled (tri-state) or set low when RESET_N is low.

4.2. VREF Reference Regulator

The H24 incorporates a regulated voltage output, VREF. The regulator provides a 2.6V output for use by the customer application. This regulator can source up to 300 mA of current to power any external digital circuits.





IMPORTANT:

The VREF regulator is powered from the H24's main power supply, and therefore any current sourced through this regulator originates from the H24 VCC supply. The overall VCC current consumed by H24 is directly affected by the VREF operation. The H24 current consumption rises with respect to the current sourced through VREF.

The VREF regulator incorporates 3 operating modes that are controlled by the AT+MVREF command. These modes define the regulator operating state relative to the H24's operating mode.

4.3. OFF Mode

In this mode the VREF regulator is disabled and its output drops to 0V, regardless of the H24 operating state.

4.4. Sleep Mode

The 300 mA rated linear regulator offers a low power mode to reduce its quiescent current during the module's sleep mode. This mode uses reduced current in the feedback loop, causing degraded performance (PSRR, output current capability, etc.). In fact, if the load increases beyond 1 mA the output voltage can go out of specification. This mode should only be used when the module is in its sleep mode.



4.5. Active Mode

In this mode the VREF regulator is always fully active while H24 is operating, regardless of the H24 operating mode.

The following table gives the VREF specifications.

Parameter	Conditions	Min	Typ	Max	Unit
V _{OUT}		-3%	2.6	+3%	V
I _{OUT}				300	mA
Load regulation				0.65	%
Line regulation				0.2	%/V
PSRR			40		dB

Table 4-2: VREF Specifications

4.6. Wakeup Out

Some applications incorporate their own power saving mode, in which they operate with minimal functionality, including disabling of interfaces and serial communications.

The wakeup-out (WKUPO_N) signal is an active low output, which is designed to support a low power mode feature in the host application. This signal is used by H24 to indicate that it requires communicating with the host application through the serial interface, due to an incoming call or data, or an unsolicited event. Applications that incorporate a low power mode should use this signal as an indication to switch from low power mode to normal operation, and activate the serial interface.

The wakeup-out mechanism, using the WKUPO_N signal, is controlled by 2 AT commands (see):

- **ATS102** - Defines the delay time in milliseconds that H24 will wait, after asserting the WKUPO_N signal low, before sending data on the serial interface. This delay is required to allow the application enough time to reactivate from low power mode and switch to normal mode.

If ATS102=0, which is the default value, the WKUPO_N signal and mechanism is disabled.

In case the serial interface incorporates hardware flow control signals, the data will be sent according to their state, after the ATS102 delay time has expired.

- **ATS100** - Defines the application minimal wakeup duration, in seconds, for a single wakeup event. This time definition is required to avoid frequent unnecessary wakeup



events and consequent ATS102 delays.

The application may return to low power mode after the serial interface has been inactive for the duration set by ATS100. This duration is measured from the last data sent or received on the serial interface.

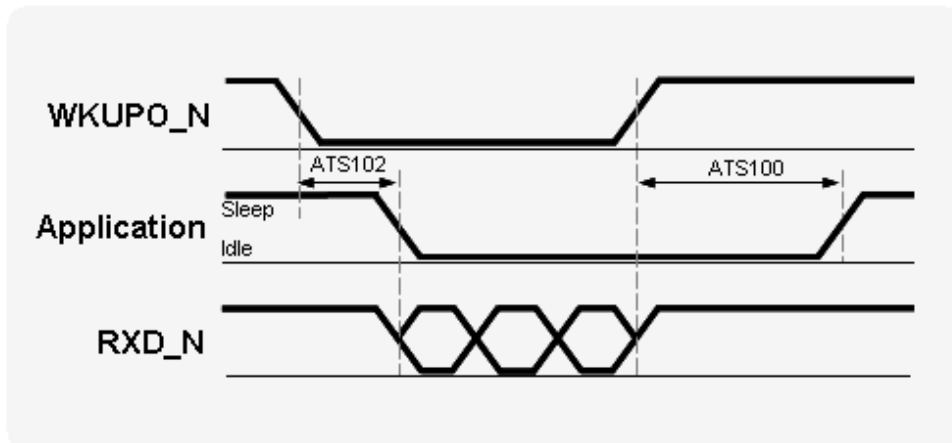


Figure 4-1: WKUPO_N Operation

The following guidelines apply to the wakeup-out mechanism:

- H24 will set the WKUPO_N signal low to indicate that it has data to send through the serial interface.
- H24 will start sending the data to the application after the delay defined by ATS102.
- The WKUPO_N signal will remain low while data is being sent to the host application.
- The host application should keep its serial interface active, and not switch to low power mode, while the WKUPO_N signal is low.
- H24 will set the WKUPO_N signal high when it has completed sending the data.
- The application serial interface must stay active, and not switch to low power mode, for the duration set by ATS100, after WKUPO_N is set high.
- H24 will not set the WKUPO_N signal low if it needs to send additional data during the ATS100 delay time.
- The application may switch to low power mode after the WKUPO_N signal is set high and the serial interface has been inactive for the duration set by ATS100.

4.7. Network Connection Detection

The network connection output signal (Pin 49) indicates the network (GPRS/EGPRS or WCDMA/HSPA) connection status. When H24 is connected to a network, this signal is enabled. When H24 is not connected to the GPRS/EGPRS or WCDMA/HSPA network this signal is disabled. This pin (Pin 49) is enabled by the command AT+MCWAKE.



4.8. Transmission Indicator

The TXEN_N output signal indicates when H24 is transmitting over the GSM or CDMA network. This signal follows the H24 GSM transmit bursts. This signal is set low during transmission burst, and set high when no transmission is in progress.

The following picture shows the TXEN_N operation.

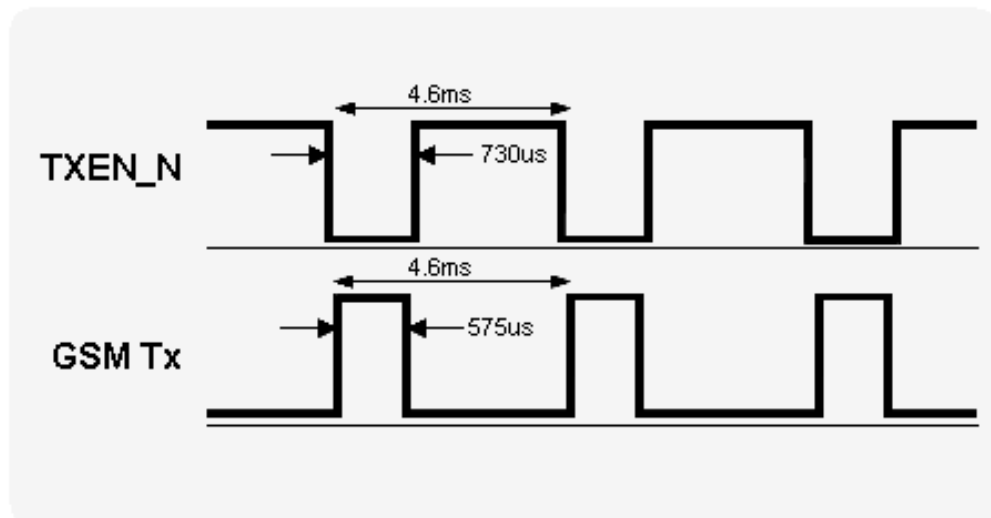


Figure 4-2: TXEN_N Operation

4.9. General Purpose I/O

The H24 incorporates 8 general purpose IO signals for the user application. Each GPIO signal may be configured and controlled by AT command. These signals may be used to control or set external application circuits, or to receive indications from the external application.



1900	RX	1930-1990 MHz
WCDMA B5 850	TX	824 - 849 MHz
	RX	869 - 894 MHz
WCDMA B4 1700	TX	1710 - 1755 MHz
	RX	2110 - 2155 MHz
WCDMA B8 900	TX	880-915 MHz
	RX	925-960 MHz

Table 5-1: Antenna Interface Specifications

It is the Integrator's responsibility to design the antenna or antenna assembly used with the H24. This will highly affect the RF performance of the H24 (dropped calls, battery consumption etc.). The following guidelines should be followed:

- Make sure that the antenna or antenna assembly matches the Antenna Interface Specifications.
- Use low loss RF cable and connectors keeping cable runs to a minimum.

5.1. Diversity

5.1.1. RX Diversity Overview

The usage of diversity antenna has a great advantage of improving receiver sensitivity.

H24 HSPA series offers antenna diversity feature to be used in the UMTS/HSPA frequency bands.

The receiver sensitivity improvement is achieved by:

- **Fading effect improvement**
While one antenna is in fade, the other antenna is probably not.
- **Better Noise Figure**
Two antennas will receive more signal power than one antenna and while combining two signals the uncorrelated noise will be reduced.
- **Interference rejection**
Combining the received signal with weighting selected so that correlated interfering signals picked up on both antennas tend to cancel each other out.

5.1.2. Performance

Typical 4dB sensitivity improvement is shown while the H24 is in conducted lab conditions:

Base station is connected with RF cables to both RX main port and RX diversity port due to diversity port usage (measured in all H24 UMTS supported bands).



5.1.3. Diversity antenna requirements

- Diversity Rx-Only antenna - typically smaller than the primary antenna.
- Antenna should be designed for the supported UMTS/HSPA bands of interest.
- UMTS/HSPA RX frequencies:

UMTS/HSPA RX Band	Frequency [MHz]
Band I	2110-2170MHz
Band II	1930-1990MHz
Band IV	2110-2155MHz
Band V	849-894MHz
Band VIII	925-960MHz

- Antenna impedance - 50Ohm.
- Free space antenna efficiency should be greater than -7 dB (20%).
- Antenna VSWR < 3:1 in free space for all bands.
- Delta gain between primary and secondary antennas should be greater than -3 dB.
- Isolation from primary antenna to secondary antenna should be greater than 8 dB.

5.1.3.1. Diversity Antenna Design Recommendations

- For better Isolation it is recommended to increase distance between primary antenna and secondary antenna as possible.
- For lower antenna correlation (lower correlation improves performance under fading conditions) it is recommended that diversity antenna polarity will be horizontal in case main antenna is vertical.
- It is important to complete TRP and TIS testing at the chamber include both primary and diversity antenna installed. These tests are typically required by the network operators as part of their acceptance requirements.



6. GPS and Antenna Interface

H24 GPS supports the following configurations:

- Autonomous GPS,
- Assisted GPS, SUPL GPS
- MS-BASE GPS

The H24 GPS has the following capabilities:

- The receiver uses a dedicated RF connector (U.FL type).
- GPS receiver can work simultaneously with a cellular connection.
- Cellular diversity receiver is disabled when GPS is active.
- Supports an Active GPS antenna only.
- The H24 will supply the DC feed to the Active antenna.
- The GPS receiver is activated by the +MNMEA AT command.



NOTE:

Refer to "H24 AT Commands Reference Manual, " for more information.

6.1. GPS Receiver Performance

6.1.1. Time To First Fix (TTFF)

- **Stand Alone TTFF**
 - Hot start < 1.2 sec average
 - Warm start < 27.1 sec average
 - Cold start < 36.7 sec average
- **Assisted MS-Based TTFF (phone calculations)**
 - Cold start 2.4sec

6.1.2. Sensitivity

Autonomous acquisition -145dBm.

Tracking -158dBm (50% valid fixes).

6.1.3. Position accuracy

- Tracking L1, CA code
- 12 Channels
- Max. update rate 1 Hz



The module is capable to provide calculated location or ranging measurements to meet the following accuracy Requirements:

- **MS-Based Mode:**
Error calculated location less than 11.1 meters 67% of the time, and less than 22.5 meters 95% of the time.
- **Autonomous/Standalone Mode:**
Error calculated location less than 11.6 meters 67% of the time, and less than 24.2 meters 95% of the time.

6.1.4. Protocol Support

- NMEA

6.1.5. Module Current Consumption

The following table gives the H24 current consumption information with operating GPS.

Mode	Average (mA)	Mode Description
Idle mode with GPS full power mode		
WCDMA	131mA	Standby mode; no call in progress; GPS ON
GSM	131mA	
WCDMA TX and RX mode with GPS ON full power mode		
WCDMA Voice	780mA	WCDMA Voice channel, 24dBm TX output power
WCDMA Data	780mA	WCDMA Data channel, 24dBm TX output power
HSDPA	790mA	HSDPA Data channel, 24dBm TX output power
HSUPA	430mA	HSUPA Data channel, 0dBm TX output power
GSM TX and RX mode with GPS ON full power mode		
GSM Voice	420mA	GSM Voice channel, 33dBm TX output power
GPRS Class 12	620mA	GPRS Data channel, 33dBm TX output power
EDGE Class 12	430mA	EDGE Voice channel, 27dBm TX output power

6.1.6. GPS Active Antenna Supply Circuit

The internal supply circuit for the external antenna has the following characteristics:

- The supply voltage can be set to 1.5V - 3.05 V DC.
- Enabling the power supply is done using the +MGPSAPWR AT command.



The following table gives a brief description of the 70 pins connector for quick integration.

GND	1	2	GND
GND	3	4	GND
VCC	5	6	VCC
VCC	7	8	VCC
RTS_N	9	10	USB_VBUS
RXD_N	11	12	USB_DP
DSR_N	13	14	USB_DN
CTS_N	15	16	WKUPI_N
DCD_N	17	18	PCM_DIN
DTR_N	19	20	PCM_DOUT
TXD_N	21	22	PCM_CLK
RI_N	23	24	PCM_FS
RESET_N	25	26	WKUPO_N
VREF	27	28	GPIO1
RXD2	29	30	GPIO2
TXD2	31	32	GPIO3
RTS2	33	34	GPIO4
CTS2	35	36	GPIO5
ADC1	37	38	GPIO6
TXEN_N	39	40	GPIO7
ANT_DET (NC)	41	42	GPIO8
ADC2	43	44	SIM_RST_N
USB_ID	45	46	SIM_CLK
ADC3	47	48	SIM_VCC
GPRS	49	50	SIM_PD_N
IGN	51	52	SIM_DIO
ON_N	53	54	HEADSET_P



HDST_INT_N	55	56	Chip SIM reset
MIC2_P	57	58	GPS_PWR
AGND	59	60	NC
MIC1_P	61	62	MIC1_N
ALRT_N	63	64	NC
ALRT_P	65	66	NC
SPKR_N	67	68	Coin Cell
SPKR_P	69	70	MIC2_N

Pin #	Signal Name	Description	I/O	Active H/L	Internal PU/PD	Parameter	Conditions	Level			
								Min	Typ	Max	Units
Power:											
1	GND	Ground									
2											
3											
4											
5	VCC	DC power supply	I			V_{IN} I_{MAX} I_{OFF}	VCC = 3.6 V	3.3	3.6	4.2	V
6									1.7	1.8	A
7									40	50	uA
8											



68	COIN CELL		I	H				1.8	3	3.25	V
58	GPS ANT POWER	Do not connect	I								V
27	VREF	Reference regulator output	O					-3%	2.6	+3%	V 300 mA
Control:											
16	WKUPL_N	H24 wakeup input	I	L	PU	V_{IH} V_{IL}	$I_{OUT} \leq 2mA$	2.0	2.6 0	2.9 0.4	V
26	WKUPO_N	Host wakeup output	O	L		V_{OH} V_{OL}	$I_{OUT} \leq 2mA$	2.15	2.6 0	2.9 0.45	V
25	RESET_N	Reset signal output	O	L		V_{OH} V_{OL}	$I_{OUT} \leq 2mA$	2.15	2.6 0	2.9 0.45	V
53	ON_N	On/Off switch	I	L	PU	V_{IH} V_{IL}		2.0	2.6 0	2.9 0.4	V
51	IGN	Ignition input	I	H	PD	V_{IL} V_{IH}		0 3.3		0.4 16	V
39	TXEN_N	Transmit indicator	O	H		V_{OH} V_{OL}	$I_{OUT} \leq 2mA$	2.15	2.6 0	2.9 0.45	V
49	GPRS	GPRS/EGPRS coverage indicator	O	H			$I_{OUT} \leq 2mA$	2.15	2.6 0	2.9 0.45	V
Primary UART:											
21	TXD_N	UART1 TXD	I	L	PD	V_{IH} V_{IL}		2.0	2.6 0	2.9 0.4	
11	RXD_N	UART1 RXD	O	L		V_{OH} V_{OL}		2.15	2.6 0	2.9 0.45	



30	GPIO2	General purpose I/O	I/O		PU		I _{OUT} ≤ 2mA				V
32	GPIO3	General purpose I/O	I/O		PU						
34	GPIO4	General purpose I/O	I/O		PU						
36	GPIO5	General purpose I/O	I/O		PU	V _{OH} V _{OL}		2.15	2.6 0	2.9 0.45	
38	GPIO6	General purpose I/O	I/O		PU						
40	GPIO7	General purpose I/O	I/O		PU						
42	GPIO8	General purpose I/O	I/O		PU						
Analog Audio:											
67	SPKR_N	Earpiece negative	O			R _L	Differential		32		Ω
69	SPKR_P	Earpiece positive	O			AV _{pp}				1.8	V
63	ALRT_N	Alert speaker negative	O			R _L	Differential		8		Ω
65	ALRT_P	Alert speaker positive	O			AV _{pp}				5.0	V
61	MIC1_P	Microphone input positive	I			R _{IN}	Differential		1		kΩ
62	MIC1_N	Microphone input negative	I			AV _{pp}		2	10	50	mV
59	AGND	Audio ground									
57	MIC2_P	Headset microphone input positive	I			R _{IN}			1		kΩ



8. Mechanical Specifications

8.1. Board Dimensions

This picture describes the H24 mechanical characteristics.

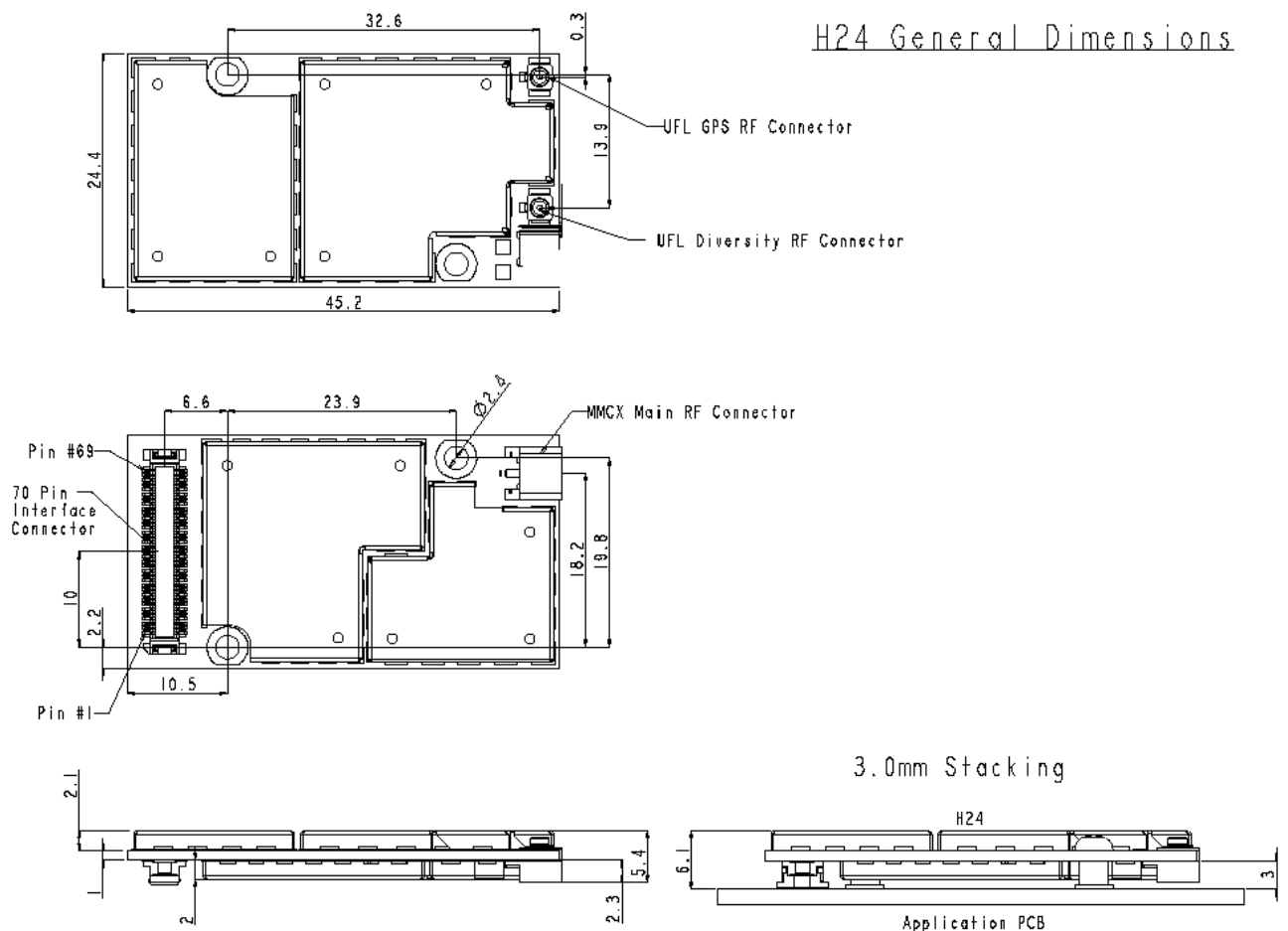


Figure 8-1: H24 Mechanical Characteristics

8.2. Interface Connector Specifications

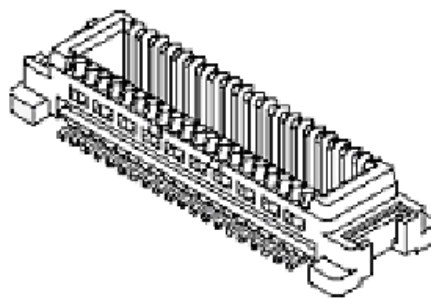
The H24 uses a single 70-pin, 0.5 mm pitch, board to board connector for the application interface, as described in the following table.



H24 Connector	Mating Connector	Stacking Height
Molex 53748-0708	Molex 52991-0708	3.0 mm

Table 8-1: H24 interface connector options

The following picture shows the H24 interface connector.



53748-0708 3.0mm

Figure 8-2: H24 Interface Connector

What follows is a description of the H24 interface connector characteristics.

- **Parameter** **53748 (3.0 mm)**
- **Contacts** **70**
- **Rows** **2**
- **Pitch** **0.5 mm**
- **Maximum Current** **500 mA**
- **Maximum Voltage** **50 V**
- **Contact Resistance** **50 mΩ maximum**
- **Insulation Resistance** **100 MΩ minimum**
- **Durability** **50 mated cycles maximum**
- **Stacking Height** **3.0 mm**
- **Mates with** **Molex 52991-0708**









Item description 11_MMCX-50-1-1/111_OH	
Connector Description	Straight cable plug for flexible cable
Series / Pattern Highlights	<ul style="list-style-type: none"> • MMCX – Type / Pattern 11 • SUHNER full crimp cable attachment
	
Item number	22651666
Data sheet	 11_MMCX-50-1-1/111_O
Outline drawing	 11_MMCX-50-1-1/111_O
Catalogue drawing	 11_MMCX-50-1-1/111_O
Related documents	 Assembly Instruction
2002/95/EC (RoHS)	 compliant
Interface Standards	SUHNER-MMCX
Mechanical data Jump to [Top]	
Cable Entry Centre Contact	crimped
Cable Entry Outer Contact	crimped
Engagement Force max	15 N
Disengagement F. min	6 N
Disengagement F. max	15 N
Dielectric Size	1
Electrical data Jump to [Top]	
Impedance	50 Ω
Interface Freq max	≤6 GHz
Environmental and general data Jump to [Top]	
Operating Temp min	-55 °C
Operating Temp max	155 °C
Weight	0.0009 kg
Number of Matings	500

Figure 8-5: Optional MMCX Cable Assembly



- 10 milliohms max (Outer, Receptacle)
- Durability 30 cycles - standard recept (Styles A, B)
- Disengagement Force 2N min perpendicular
- 4N min orthogonal
- Center Contact Retention force 0.15N min
- Tape/Reel Packaging (receptacle) 12mm carrier per EIA-481
- Operating Temperature 40°C to + 90°C

8.4.1. Mating Connector

The RF mating connector should be a standard U.FL plug connector or cable assembly, which corresponds to the H24 U.FL connector specifications.

Only Hirose U.FL mating cable may be mated with H24. A family of Hirose mating cables are available.

Such a cable assembly example is the Hirose U.FL-LP-040 is U.FL-R-SMT, which is illustrated in the following picture.

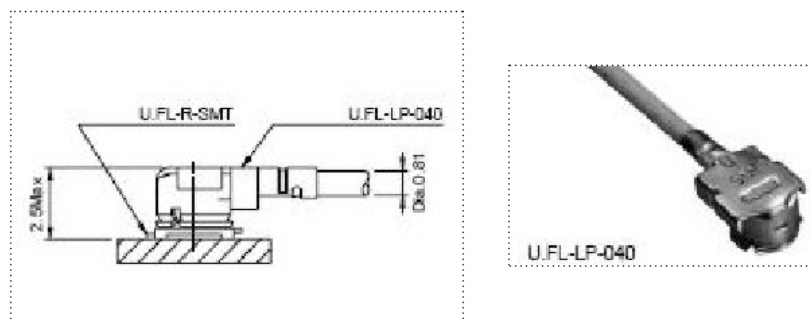


Figure 8-7: U.FL Mating Connector

For more details regarding Hirose mating cable assemblies, refer to http://www.hirose.co.jp/cataloge_hp/e32119372.pdf.

8.5. H24 Mounting

The H24 incorporates 2 mechanical holes for installing the module onto the application board. The holes are 2.4 millimeters in diameter, which accommodates several types of mechanical elements.

Several mechanical approaches may be applied to mount and fasten H24 to the application board. Using M2 screws with suitable washers to mount the module onto spacers, a bracket or chassis is a recommended design.

Special attention must be paid to the area surrounding the H24 mounting holes. A grounding pad of 4.4 millimeters in diameter surrounds these holes. The diameter and area of this pad must not be exceeded by any mechanical or electrical element. Several electrical components, which are not shielded, are located near the holes. These components must not be in contact with the mounting elements or with other parts of the application board, and care must be taken to avoid any damage.



The following picture depicts the H24 mounting area.

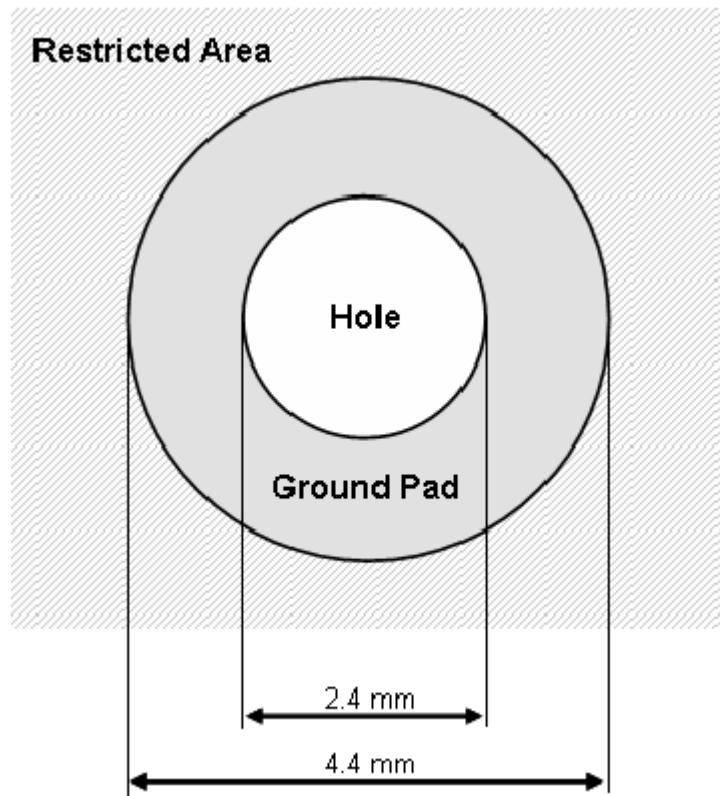


Figure 8-8: H24 Mounting Area

The holes are used for mechanical mounting of H24 to the application board but also for grounding support. Using conductive elements to install H24 significantly improves the overall grounding of the module and therefore improves the H24 performance and stability.

It is required to use screws or other mechanical elements to fasten H24 to the application board, but it is highly recommended to use conductive elements to improve the module's performance.

The preferred mounting screw head types are:

- "Allen" head with a chamfer - the best choice.
- "Star" head - good.
- "Philips" head - may cause damage to nearby components.



