GSPS Core Module 2.0 VAM-CM HW Description

Version 0.9

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Contents

1: Purpose

The purpose of this document is to describe the VAM-CM HW external interfaces.

2: Scope

This document describes the HW Interfaces of VAM-Core Module (VAM-CM). Interfaces of VAM-CM are dedicated for VAM manufacturers to interface their own satellite terminal UI and control electronics.

The intended audiences are engineers from Inmarsat, LM, manufacturing partners, VAM manufacturers and Sasken and a working knowledge of the Inmarsat space segment and GMR2+ specification is assumed.

2.1: References

Reference	Document	Version
[R1]	*VAM Tool User Guide*	1.0
[R2]	*Standard and Proprietary AT Commands*	1.0-1
[R3]	*VAM Core Module User Guide*	0.9

3: VAM-CM Overview

The main goal in VAM-CM design is to utilize the IsatPhone 2 high level architecture and provide a compact core module with a simple single connector control interface to enable board to board connection.

3.1: VAM Terminal Architecture

A GSPS VAM terminal shall consist of a VAM-CM that is interfaced via and controlled by a VAM controller board. The VAM controller board takes care of the external interfaces from the user to VAM-CM and is responsible for VAM CM modem control. *Figure 1* shows an example architecture of a VAM terminal including the VAM-CM, VAM controller and basic interfaces. The VAM-CM interface is described in more detail in **VAM-CM interfaces** on page 11.

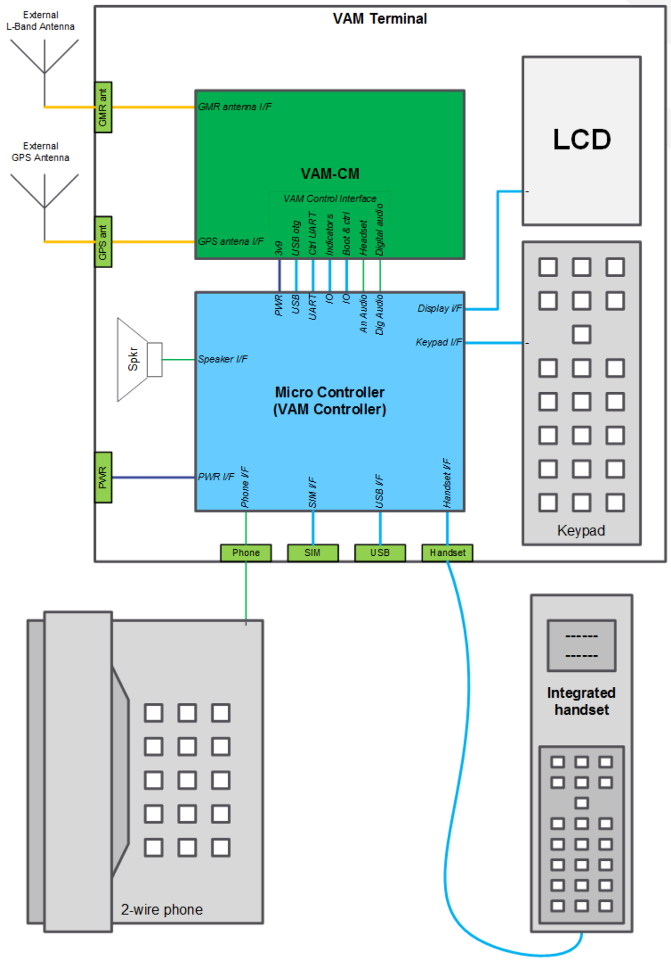

Figure 1. VAM Terminal Architecture

3.2: VAM-CM Concept

The target of VAM concept was to produce small GMR 2+ modem with simple cost effective RF and control interfaces. The VAM-CM design shown in *Figure 2* is optimized from the IsatPhone 2 platform design by excluding non-necessary handset related interfaces and features, by including industry standard 'board to board' interface connectors and by optimizing the PWB area consumption.

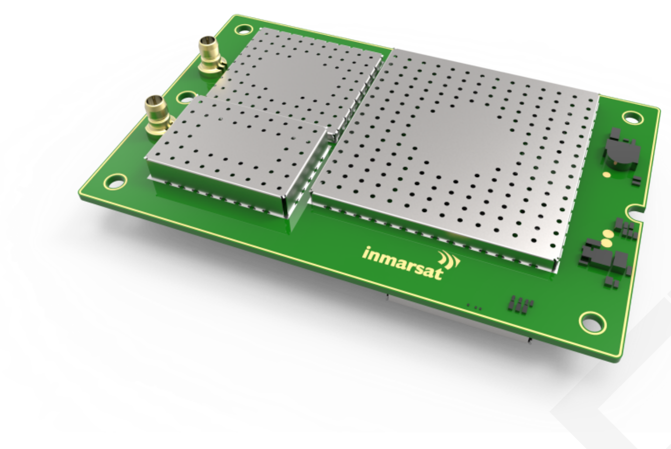

Figure 2. VAM-CM

Due to the simple and compact interfaces, testing and evaluation of the VAM-CM requires interface extension to enable easier access to control and indication signals. The VAM-CM Evaluation Module available from Inmarsat provides easier and more convenient interfacing to the VAM-CM during terminal test and evaluation phases.

3.2.1: Evaluation module

The Evaluation Module is intended for VAM terminal product HW and SW development and extracts the VAM-CM control and SIM card pin header interfaces to standard interfaces as well as providing some system setting possibilities.

Evaluation module and control software are described in more detail in **Evaluation tools** on page 22

3.3: VAM-CM Architecture

3.3.1: High Level System Design

Figure 3 shows the HW architecture of the VAM-CM platform.

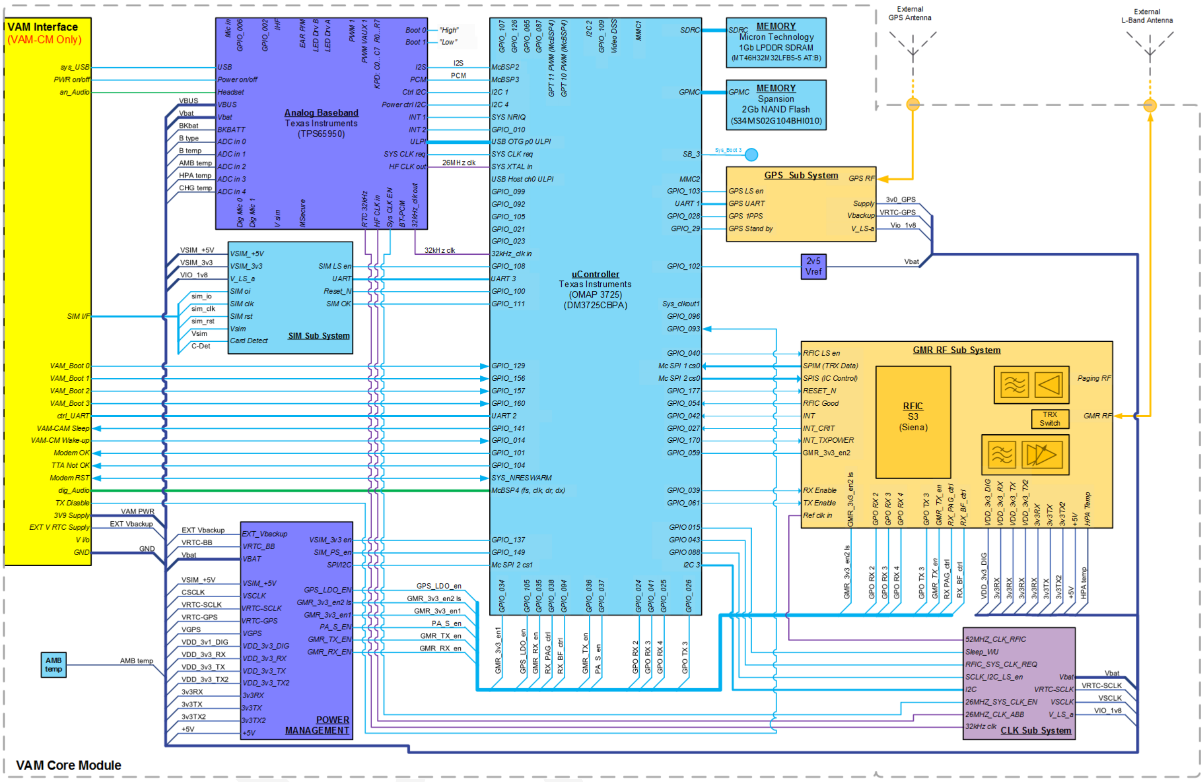

Figure 3. Block diagram of IsatPhone 2v1 VAM-CM

3.3.2: VAM Control interface

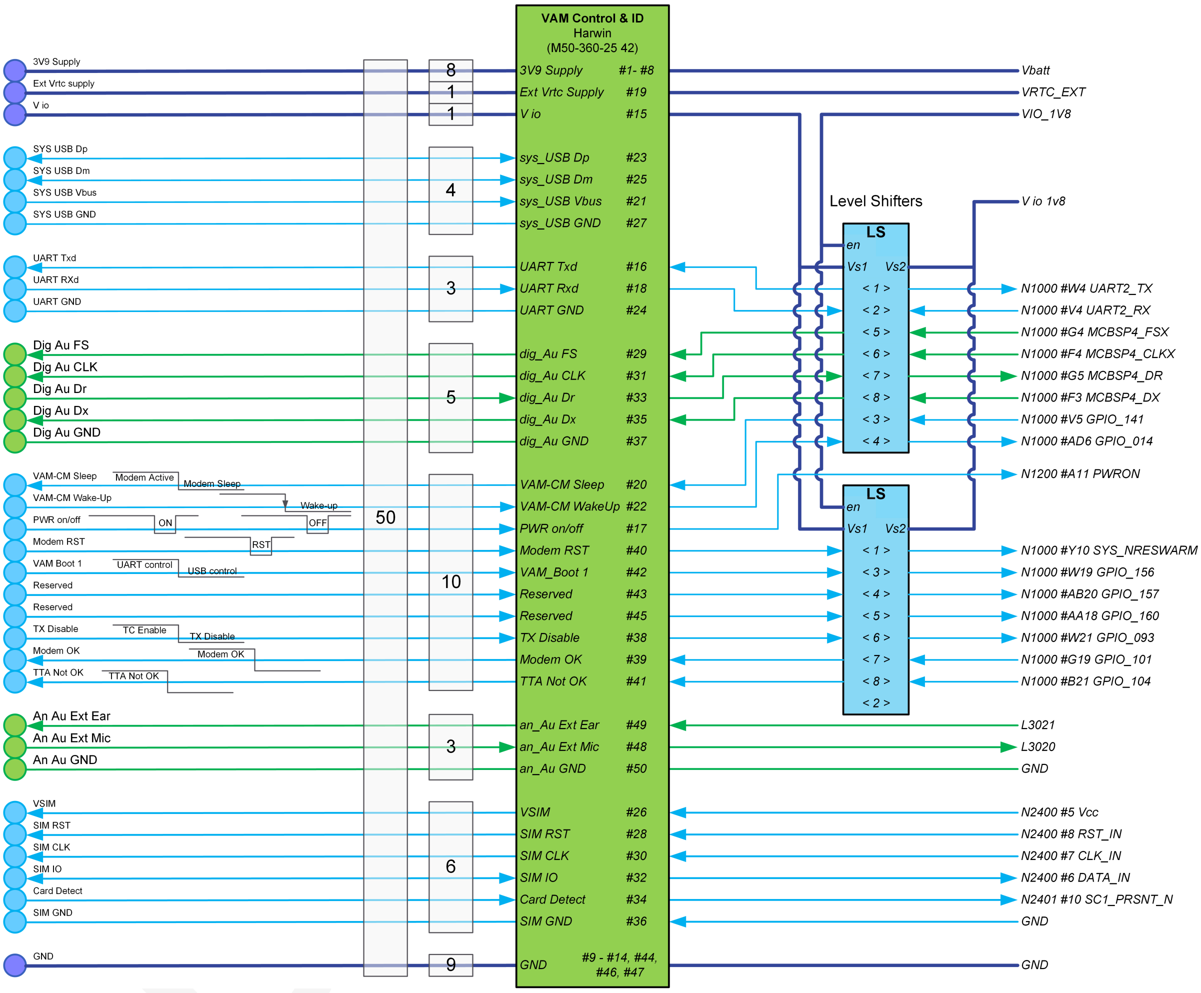

Figure 4. VAM control interface

The VAM control interface is marked with a blue dashed line in *Figure 3* above. *Figure 4* shows the VAM Control and ID interface and pin header connector.

VAM Control and ID interface includes the following baseband interfaces; for more detail, see **VAM-CM interfaces** on page 11.

- System USB
  - Direct USB interface to access VAM-CM for direct controls and firmware updates. This interface can also be used as VAM control interface if selected by VAM Boot selection.
- USIM interface
  - Interface for external USIM socket located in VAM terminal.
- VAM control UART
  - UART interface to control VAM-CM functions. UART is the default interface for VAM control. USB control mode can be selected by VAM Boot selection.

- Analog Audio interface
    - Analog audio in (Ext Mic) and audio out (Ex Ear) signals.
- Digital Audio interface
    - Digital PCM audio interface
- Power Supply interface
    - Power supply for VAM-CM
- Control and ID interface
    - Digital operating mode controls
    - This interface includes VAM CM boot mode pins to initialize VAM CM in correct operating mode. (Control interface, audio interface, modem reset etc.)
    - This interface also includes some informative data from VAM CM. (Modem Good, TTA Not OK, etc,)

4: VAM-CM interfaces

This chapter describes all VAM-CM external interfaces. These interfaces are divided into three sections; VAM Control and ID interface, radio interface and mechanical interface. In addition there are also several test points located in the PWB which can be used for debugging and verification purposes.

Pin numbers for signals are subject to change during the development phase of the device.

Figure 5 shows the location of the interfaces in the VAM-CM. Interfaces are specified in more detailed in the following chapters.

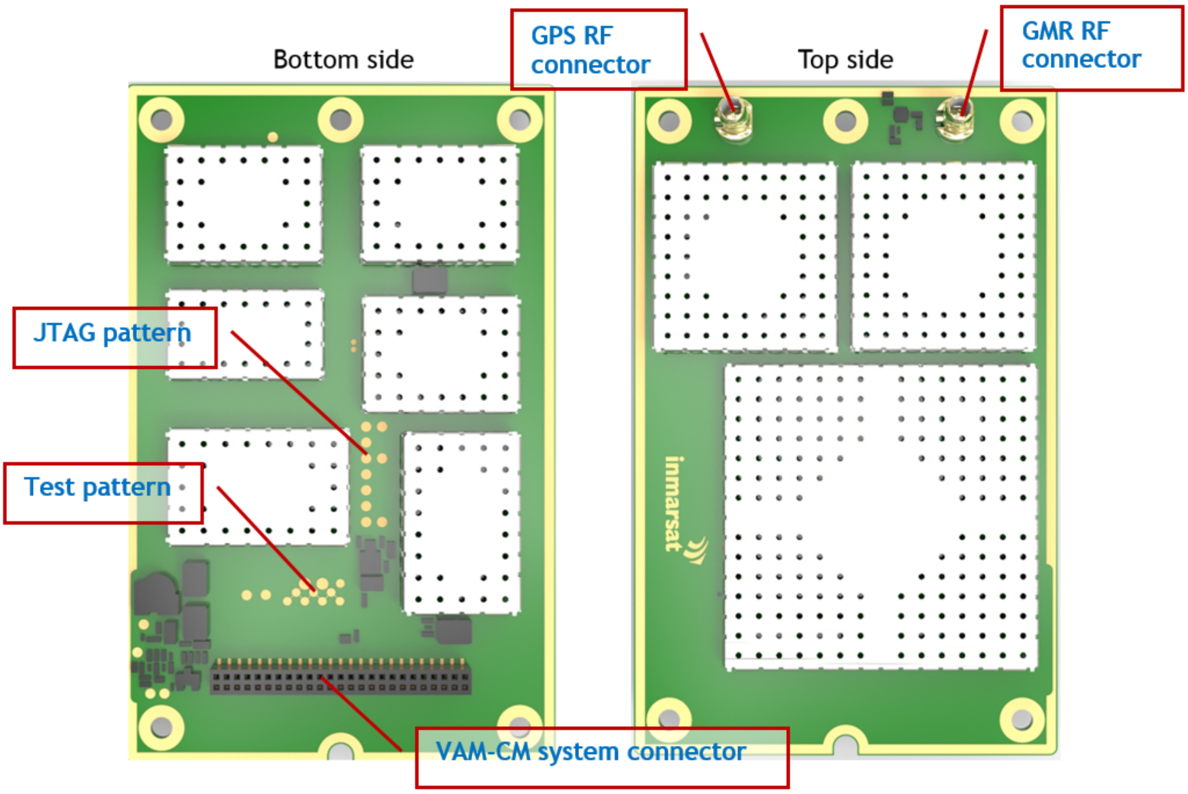

Figure 5. VAM-CM interface locations

4.1: Absolute maximum ratings

Signal	Description	Min	Max	Unit
USB	USB interface	0	4,5	V
UART	UART interface	-0,5	5,5	V
Digital Audio	Digital audio interface	-0,5	5,5	V
Analog audio	Analog audio interface	0	4,5	V
Control	Level shifter interface	-0,5V	5,5	V
SIM	SIM interface	-0,3	5,5	V

Signal	Description	Min	Max	Unit
PWR on/off	Power on/off control	0	4,5	V
Supply	Supply voltage	2,1	4,5	V
Vio	IO system voltage	-0,5	5,5	V

Table 1. Absolute maximum ratings

4.2: VAM Control interface description

The VAM control interface is a combination of digital and analog baseband interfaces dedicated to control the VAM-CM. The Interface also includes other user interface related signals like USIM and audio. The VAM control interface is a Harwin M50-360-25 42 male type pin header connector. The Connector is located so trace lengths are short enough to enable correct functionality of all interfaces.

The VAM-CM processor (DM3725) uses 1,8V I/O system. In order to protect the processor, digital interfaces are connected via level shifters. A VAM terminal can determine the interface voltage level by applying the desired V_io voltage to the VAM control interface connector. Voltage requirements for logic levels are shown in *Table 2*. For more details, see **Power Supply interface description** on page 16.

Description			Min	Max	Unit
V_{IH}	High level input voltage		$V_{IO} - 0,4$	V_{IO}	V
V_{IL}	Low level input voltage		0	0,15	V
V_{OH}	High level output voltage		$V_{IO} * 0,67$	V_{IO}	V
V_{OL}	Low level output voltage	$V_{IO} < 3V$	0	0,4	V
		$V_{IO} >= 3V$		0,55	V

Table 2. Logic levels for Level Shifter

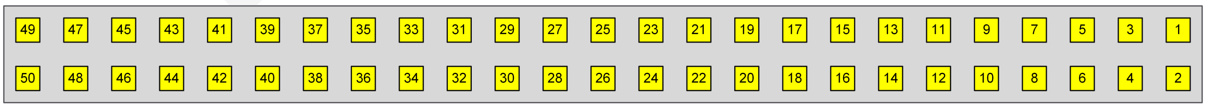

Figure 6. VAM-Control interface connector

Figure 6 shows the connector used for VAM control interface and pin arrangement. Following chapters describe the sub interfaces and their location in connectors.

4.2.1: System USB description

The system USB interface is a dedicated interface providing access to the VAM-CM. This interface is targeted for firmware updates and direct VAM-CM controls. The system USB connector shall be routed out from VAM terminal for direct access. The system USB interface can also be used for VAM-CM control when USB mode is selected with VAM Boot selector during VAM-CM power-on. The VAM can put CM in low power mode by sending USB **suspend** command and wakeup is initiated by sending **resume** command. Refer to **VAM-CM USB interface PM Handling** on page 20 for CM low power (Sleep state) handling.

System USB interface signals are located in VAM Control interface as described in *Table 3*.

Pin	Signal	Description
#21	VBUS	Supply voltage, 5,5V max
#23	Dp	Digital data
#25	Dm	Digital data
#27	GND	Signal GND

Table 3. System USB interface pins

4.2.2: USIM interface description

The USIM interface provides USIM interface from the VAM-CM to VAM terminal for easier user access.

The USIM reader in VAM terminal should be placed so that trace length from VAM control interface to USIM reader shall not exceed 300mm.

USIM interface signals are located in VAM Control interface as described in *Table 4*.

Pin	Signal	In/out	Description
#26	SIM_V	Out	Supply voltage for SIM.
#28	SIM_RST	Out	Digital data
#30	SIM_CLK	Out	Digital clock
#32	SIM_IO	In/Out	Digital data
#34	Card detect	In	"HIGH" (Float) = Card not present "LOW" = Card present
#36	SIM_GND		Signal GND

Table 4. USIM interface pins

4.2.3: VAM control UART interface description

The VAM control UART interface provides for VAM terminal to control VAM-CM features. The UART interface is connected via level shifter circuit which allows VAM terminal to determine the signal voltage level using V_io pin in VAM-CM system connector.

The UART control interface is the default control interface for VAM-CM. The Control interface can be changed to USB using VAM Boot selector (*Table 9*).

VAM control UART interface signals are located in VAM Control interface as described in *Table 5*. VAM-CM is using 2-wire UART interface with TXD, RXD signals. VAM_CM_WAKEUP and VAM_CM_ SLEEP signals is used to wake up CM from sleep state (low power mode) and to get CM sleep state status, refer **VAM-CM UART interface PM Handling** on page 20 section for CM low power (Sleep state) handling

Pin	Signal	In/Out	Description
#16	TXD	Out	UART transmit data
#18	RXD	In	UART receive data
#24	GND		UART GND

Table 5. VAM control UART interface pins

4.2.3.1: Voltage levels

The UART control bus is equipped with level shifter in VAM-CM board. This solution enables VAM to adjust I/O voltage system by applying own V_io voltage to VAM control interface connector. Voltage requirements for logic levels are shown in *Table 2*. More details in chapter **Power Supply interface description** on page 16.

4.2.3.2: Interface control

UART control interface operation modes can be set using AT commands. More detailed information about communication mode settings can be found in *Standard and Proprietary AT Commands*.

4.2.3.3: Data formats

UART control interface uses protocol with 8 data bits and 1 stop bit. Parity bits are not used in UART communication. UART communication speed is 115200bps (bits per second).

4.2.4: Analog Audio interface description

The Analog audio interface is dedicated for simple audio interface for VAM terminals having analog audio devices. Extensive care needs to be taken in analog audio interface design to avoid introducing additional noise into audio signals.

Analog audio signals are located in VAM Control interface as described in *Table 6*.

PIN	Signal	Description				
		Parameter	min	typ	max	unit
#48	Audio Input	Input resistance	50	60	70	ohm
		Input capacitance	0		200	pF
#49	Audio Output	Load resistance	14	16		ohm
		Load capacitance		100		pF
		peak output 0dBFs		1,5		Vpp
		Peak output with 0dB gain settings				
#50	GND	Audio GND				

Table 6. Analog audio interface pins

4.2.5: Digital Audio interface description

The Digital audio interface is dedicated for simple audio interfacing in cases where VAM terminal has digital audio processing applied. The Digital audio interface is connected via level shifter circuit which allows VAM terminal to determine the signal voltage level using V_io pin in VAM-CM system connector.

Digital audio interface signals are located in VAM Control interface as described in *Table 7*

Pin	Signal	In/Out	Description
#29	dig_Au_FS	In / Out	Frame sync
#31	dig-Au_CLK	In / Out	Clock
#35	dig_Au_Dx	Out	Data out

Pin	Signal	In/Out	Description
#33	dig_Au_Dr	In	Data in
#37	GND		GND

Table 7. Digital audio interface pins

4.2.5.1: Voltage levels

The Digital audio bus is equipped with level shifter in the VAM-CM board. This solution enables VAM to adjust I/O voltage system by applying own V_io voltage to VAM control interface connector. Voltage requirements for logic levels are shown in *Table 2*. For more details, see **Power Supply interface description** on page 16.

4.2.5.2: Data formats

Two modes are available for the PCM protocol: mode 1 and mode 2. For both modes, there are two types of operation: mono and stereo channels. The difference between PCM mode 1 and PCM mode 2 is in the way they use either the rising or the falling edge of the clock signal, and the frame-synchronization polarity.

- PCM Mode 1: Input data is latched on the falling edge of the clock, and the transmitted data starts on the rising edge of the clock. Frame-synchronization pulse is active high.
- PCM Mode 2: Input data is latched on the falling edge of the clock, and the transmitted data starts on the falling edge of the clock. Frame-synchronization pulse is active low.

Figure 7 and *Figure 8* shows an example of PCM protocol, mode 1 and mode 2, respectively, for a frame composed one word (width: 32 bits) with 16 bits data.

More detailed information concerning PCM interface can be found in *Texas Instruments DM3725 documentation*.

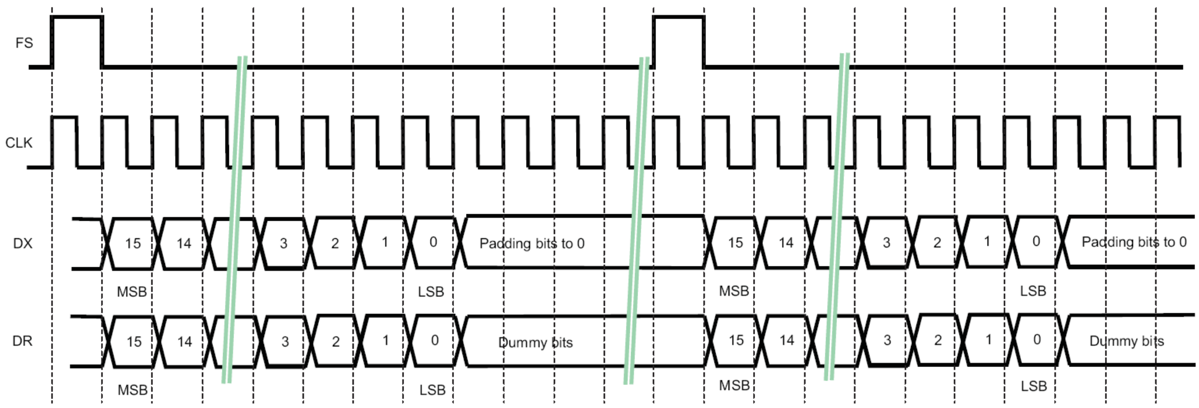

Figure 7. PCM Protocol – Mode 1 Data Format

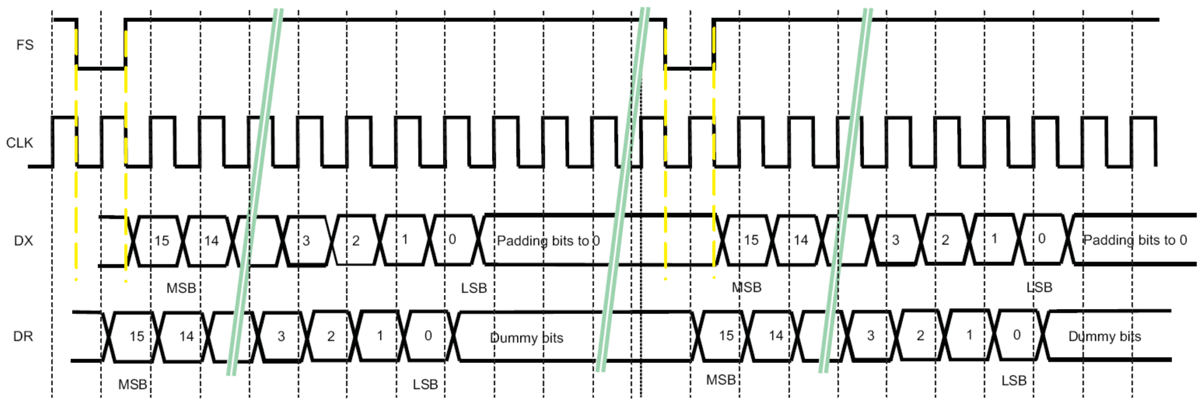

Figure 8. PCM Protocol – Mode 2 Data Format

4.2.6: Power Supply interface description

The Power supply interface contains multiple pins to share high current flow of one pin to several pins. Additional grounding pins are spread out for different sub-interfaces.

Digital interfaces to VAM-CM processor (DM3725) are connected via level shifters. VAM terminal can determine the interface voltage level by applying interface voltage in V_io pin (#15) of VAM-CM system connector. V_io can be selected between 1,65V … 5,5V.

Power supply interface pins are located in VAM Control interface as described in *Table 8*

Pins	Signal	Description
#1, - #8	3v9	Power Supply for VAM-CM 3,9V (min3,6V, max 4,2V) 1,0A rms (4A peak)
#9 - #14, #44, #46, #47	GND	Power Supply GND
#15	Vio	I/O voltage supply for level shifters in VAM-CM Vio voltage range 1,65V … 5,5V
#19	Ext Vrtc supply	External backup voltage supply to enable possibility to arrange external battery backup supply for RTC and backup features. 3,3V (maximum load 1mA)

Table 8. Power Supply interface pins

4.2.7: External VRTC Supply Functionality

Internal RTC battery is left out from the VAM-CM design. Ext Vrtc supply input is however included in VAM system interface to allow possibility to feed external back-up voltage for VAM-CM to enable warm start in case of long term cut off of 3v9 Supply. Internal buffer capacitors in VAM-CM will maintain back-up voltage for 10 seconds which is meant to keep up back-up operation during short 3v9 supply cut-offs.

Back-up voltage is internally supplied in VAM-CM meaning that if 3v9 Supply is available for VAM-CM, also internal back-up voltage is present. Powering off the VAM-CM does not shut down internal back-up voltage supply. Omission of Ext Vrtc supply has influence only in case that 3v9 Supply is cut off for some reason.

Back-up voltage keeps on the slow clock (32kHz), RTC date information and GPS satellite status information. When back-up voltage goes down this information is lost and VAM-CM needs to make cold start which will add about 35 seconds (GPS fix, TTA calculation) to warm start time.

4.2.8: Control and ID interface description

The Control and ID interface is provided to set dedicated operating modes for VAM-CM for different use cases. These modes can be related for boot-up or control mode. Control and ID interface is connected via level shifter circuit which allows VAM terminal to determine the signal voltage level using V_io pin in VAM-CM system connector (*Table 8*). Power on/off control is not connected via level shifter to enable powering up the VAM-CM when level shifters are not active.

Control and ID interface pins are located in VAM Control interface as described in *Table 9*

Pin	Signal	In/Out	Description
#17	Power On/Off	In	"0,5…1s LOW pulse" Turns modem on or off depending of current state. "FLOAT" = Rest state no action
#20	VAM-CM Sleep	Out	Indicates VAM-CM sleep mode status "HIGH" – Modem Active "LOW" – Modem Sleep
#22	VAM-CM Wake-up	In	VAM-CM wake-up control input "Rising edge" – Modem wake-up
#38	TX Disable	In	VAM-CM transmitter control input "LOW" = TX operation of VAM-CM disabled "HIGH" = normal operation
#39	Modem OK	Out	Indicates modem status "LOW" = Modem not ready for operation "HIGH" = Modem OK
#40	Modem RST	In	Warm reset for VAM-CM "LOW" pulse for 1s to reset the VAM-CM "High" normal operation
#41	TTA Not OK	Out	Modem synchronization status "LOW" = Modem is OK for calls "HIGH" = No TTA available
#42	VAM Boot 1	In	Control interface selection. "LOW" = during power on for USB control "HIGH" = during power on for UART control

Table 9. Control and ID interface pins

4.2.8.1: Signal conditions

The Control and ID interface is equipped with level shifter in VAM-CM board. This solution enables VAM to adjust I/O voltage system by applying own V_io voltage to VAM control interface connector. For more details, see **Power Supply interface description** on page 16.

Power on/off is not controlled via level shifter. Power on/off is pull down type control having internal pull-up resistor for "HIGH-state" implemented in VAM-CM board. Power on/off action is achieved by pulling this line to GND so no level shifting is needed. Power on/off line shall be floating when inactive, no external pull-up is allowed.

4.3: Radio interface description

4.3.1: GMR2 transceiver antenna interface

Dedicated antenna interface for GMR2 transceiver. The antenna interface uses snap on SMB connector JAE SMB003D00 to provide cost efficient and robust interfacing for RF signal. *Figure 9* shows the connector used for GMR2 RF transceiver antenna interface.

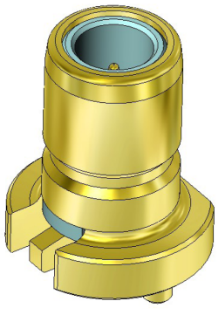

Figure 9. GMR2 transceiver antenna interface connector

Signals in GMR2 transceiver antenna interface are connected as shown in *Table 10*.

Pin	Signal	Description
Center	GMR RF	Frequency: 1518 MHz – 1675 MHz Power: output +33,5 dBm MAX input-10dBm MAX
Frame	GND	Signal GND

Table 10. GMR2 transceiver antenna interface pins

4.3.1.1: External antenna requirements.

External GMR antenna shall meet following baseline requirements (RF cable losses not included in antenna gain figures). It shall be noted that actual antenna performance requirements are dependent on terminal type (fixed, maritime etc). Detailed antenna requirements may be provided by Inmarsat on request.

	min	max	Unit
Frequency band	1518	1675	MHz

	min	max	Unit
Pass band impedance	50	50	Ohms
Pass band gain	2		dBic
Extended band gain	0		dBic
Axial ratio		4	dB
Extended band Axial ratio		6	dB
Extended band frequencies: RX 1518…1525MHz, TX 1668…1675MHz			

Table 11. GMR external antenna requirements

4.3.2: GPS receiver antenna interface

The GPS receiver Antenna interface uses snap on SMB connector JAE SMB003D00 to provide cost efficient and robust interfacing for RF signal. *Figure 10* shows the connector used for GPS RF receiver antenna interface.

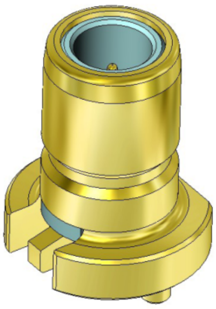

Figure 10. GPS receiver antenna interface connector

Signals in GMR2 transceiver antenna interface are connected as shown in *Table 10*.

Pin	Signal	Description
Center	GPS RF	Frequency: 1575 MHz – 1605 MHz Power: -20 dBm MAX
Frame	GND	Signal GND

Table 12. GPS receiver antenna interface pins

4.3.2.1: External GPS antenna requirements.

External GPS antenna shall meet following requirements (RF cable losses not included in antenna gain figures).

	min	max	Unit
Frequency band	1575	1605	MHz
Pass band impedance	50	50	Ohms
Pass band gain	0		dBi

Table 13. GPS external antenna requirements

4.4: VAM-CM Power Management Handling

The VAM-CM power management handling is based on VAM-CM control interface, UART or USB. This is required to put CM in low power mode to reduce CM power consumption.

4.4.0.1: VAM-CM USB interface PM Handling

In the VAM-CM USB control interface, core module (CM) supports USB suspend/resume feature as per USB2.0 standards to put in low power mode. By default low power mode is disabled in CM and CM can be put into low power mode based on USB suspend signal and wakeup based on resume signal, see**References** on page 5 section 7.1.7.6 and 7.1.7.7. Without handling USB suspend/resume the CM will not enter low power mode and hence overall current consumption will be more. It is recommended that the VAM should implement USB suspend/resume feature to put CM in low power mode and wakeup from low power mode.

4.4.0.2: VAM-CM UART interface PM Handling

In VAM-CM UART control interface, core module (CM) low power mode (sleep) is by default enabled and VAM can get sleep state and wakeup from sleep state using VAM_CM_SLEEP and VAM_CM_WAKEUP signals. VAM can check CM sleep state using VAM_CM_NSLEEP signal, high=Active and low=sleep. VAM need to check VAM_CM_SLEEP signal before sending any data to CM and if this signal is low then set VAM_CM_WAKEUP signal high for 100mSec to wakeup CM and ready to process data. See *Table 9* for Sleep and Wake-up signal details.

4.5: Mechanical interface

Mechanical dimensions and mounting points are shown in *Figure 11* - *Figure 13*. VAM-CM can be mounted with four 2,5mm screws from the module corners. 5mm extension towers are required to mount VAM-CM so that tightening the screws does not introduce any forge to components and shield can soldered on the board.

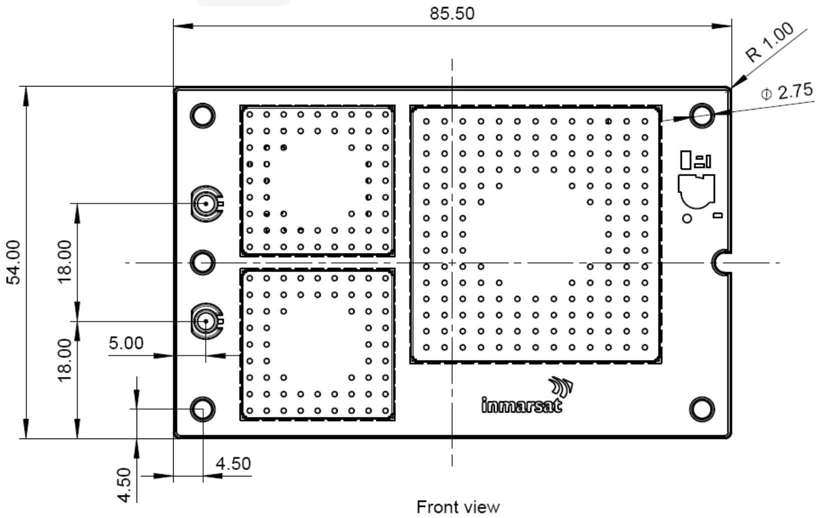

Figure 11. Front view dimensions

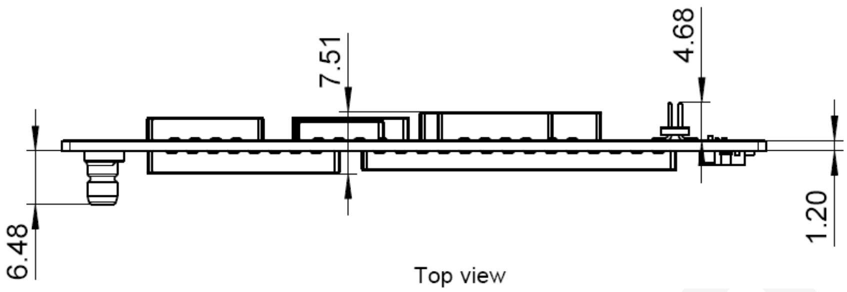

Figure 12. Side view dimensions

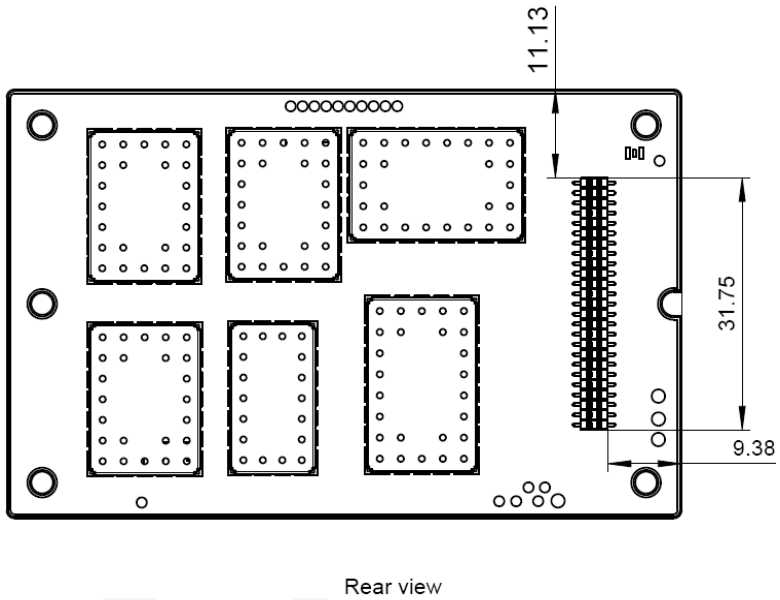

Figure 13. Rear view dimensions

4.6: Environmental conditions

Environmental operating conditions for VAM-CM are shown in *Table 14*.

	Min	Nominal	Max	Unit
Operating temperature	-20	+25	+70	Celsius degrees
Humidity	0		90	%
Vibration		0,96 0,96		m^2/s^2 5 Hz to 20 Hz m^2/s^2 20 Hz to 100 Hz (30 minutes/axis) (thereafter -3dB/octave)

Table 14. Environmental requirements

5: Evaluation tools

This chapter gives more detailed information concerning the evaluation module and control software included in evaluation kit.

5.1: Evaluation kit

The VAM-CM evaluation kit includes VAM-CM evaluation module, control software and documentation. VAM terminal manufacturer can use evaluation kit to verify the VAM-CM functionality by controlling VAM-CM directly with control SW. The evaluation kit also allows VAM terminal manufacturer to connect their own controller board to evaluation kit and verify planned interfaces.

Figure 14 shows the simplified visualization of the evaluation module.

Figure 14. VAM-CM Evaluation module visualization

5.2: Evaluation module

The Evaluation module is built to ease handling and evaluation of VAM-CM product. Evaluation module shown in *Figure 15* contains VAM-CM evaluation board and VAM core module packaged in a simple mechanical structure. VAM-CM interfaces are extracted with VAM-CM evaluation board to make interfacing and control of VAM-CM easier.

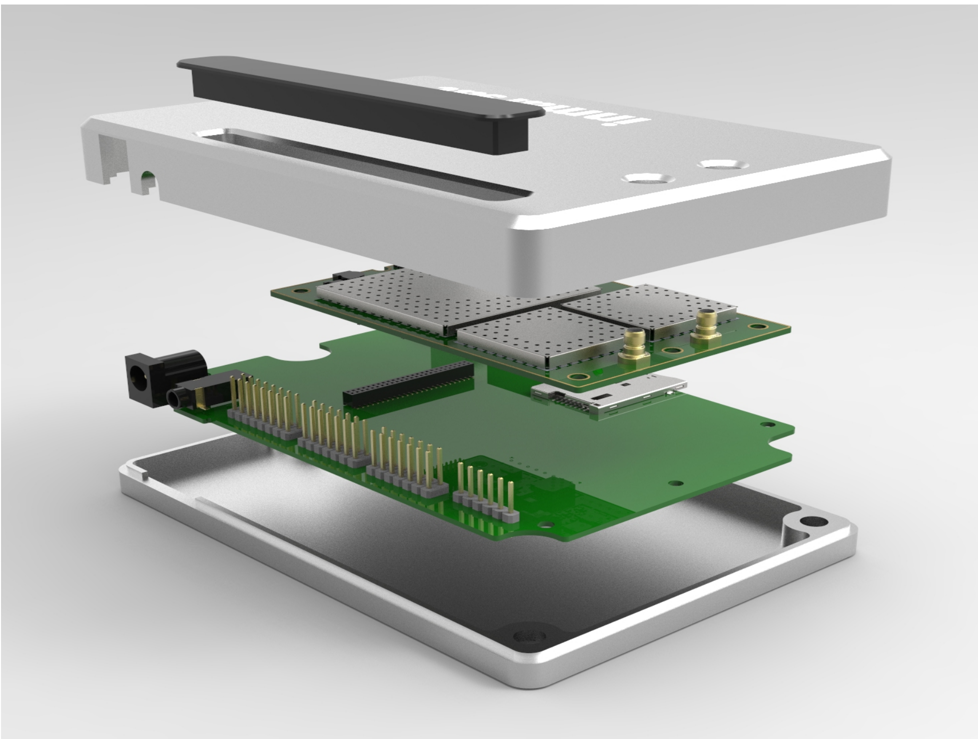

Figure 15. VAM-CM Evaluation module break down

5.2.1: Evaluation module size

The evaluation board is designed to hold the VAM-CM module and standard interface connectors, control switches and indicators. Dimensions of Evaluation board shown in *Figure 16* are 80mm by 130mm by 14,4mm excluding the extension length of parts reaching through the mechanical structure.

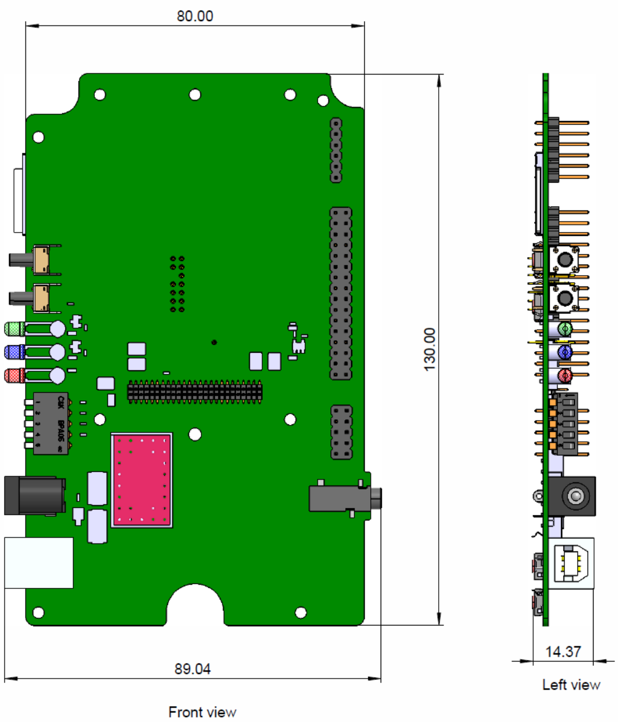

Figure 16. VAM-CM Evaluation board dimensions

Mechanical structure of evaluation module is milled aluminium. Dimensions of mechanical structure shown in *Figure 17* are 90mm by 140mm by 20,6mm excluding the rubber feet.

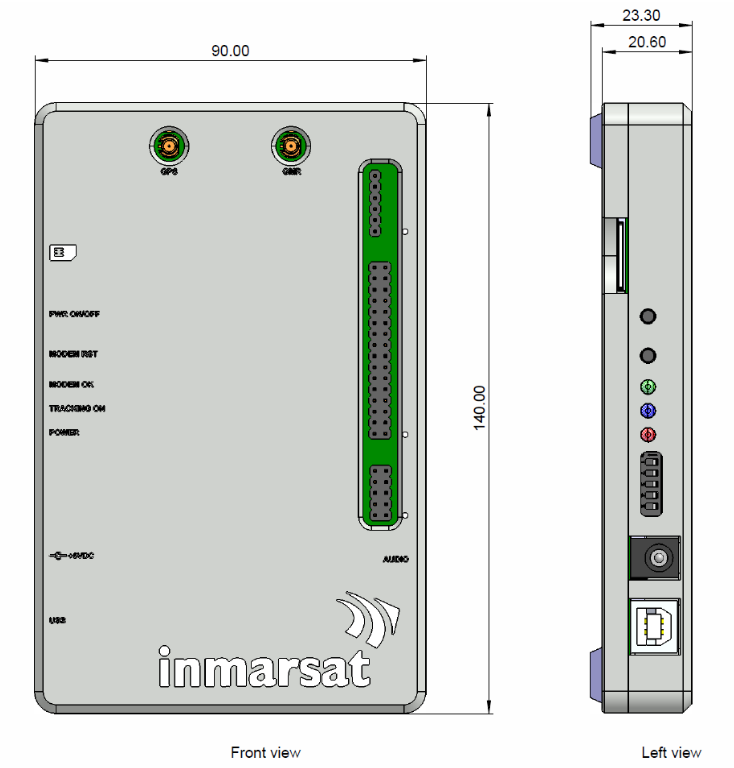

Figure 17. VAM-CM Evaluation module dimensions

5.2.2: Evaluation module interfaces

This chapter describes the outer Indicators and interfaces of VAM-CM evaluation module. Interface location can be seen in *Figure 18*. SIM socket and Boot switch are marked with red colour indicating that component is at bottom side of the evaluation board. Other interfaces (marked with blue colour) are located on top side of PWB.

Interfaces are designed so that basic interfacing can be done with standard connectors e.g. USB, UART, SIM and Audio. In addition there are also pin headers to provide easier interfacing with controller board.

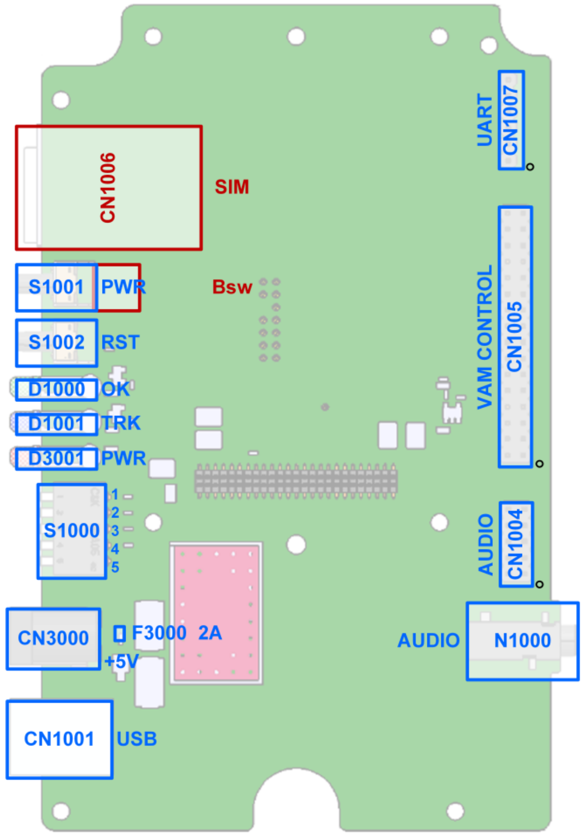

Figure 18. VAM-CM Evaluation module interface locations

Each interface is described in following chapters. Following chapters also indicate the special arrangements when pin headers are applied instead of standard interfaces.

Pin numbers for signals are subject to change during R&D phase of the device.

5.2.2.1: Indicators

Evaluation module includes LED indicators showing the status information of the system. Available status information is shown in *Table 15*.

Indicator	Name	Color	Description
D3001	PWR ON	BLUE	Supply voltage for VAM-CM is active.
D1000	Modem OK	GREEN	VAM-CM Modem is active.
D1001	TTA Not OK	RED	VAM-CM active but does not have network connection

Table 15. Evaluation module indicators

5.2.2.2: Buttons and switches

The evaluation module includes control switches allowing the user to control the operations of the VAM-CM. Controls are implemented with two push button switches S1001 for Power on/off and S1002 Modem RST.

Boot selection switch S2003 is located at bottom side of PWB available only with pin tool via small hole in mechanics. This button is used to make VAM-CM to boot from USB device to start firmware upgrade tool or enable direct USB flashing. Boot selection is required during R&D phase firmware updates.

VAM-CM control buttons are shown in *Table 16*.

SW	Control	Description
S1001	PWR on/off	Power on/off switching of VAM-CM.
S1002	Modem RST	Warm reset for VAM-CM.
S2003	USB Boot SW	Boot selection switch

Table 16. Evaluation module control buttons

5 way switch block S1000 allowing user to set-up and control the VAM-CM operation. Order of switches in switch block is represented in *Figure 19*. Functions of included VAM-CM controls are shown in *Table 17*.

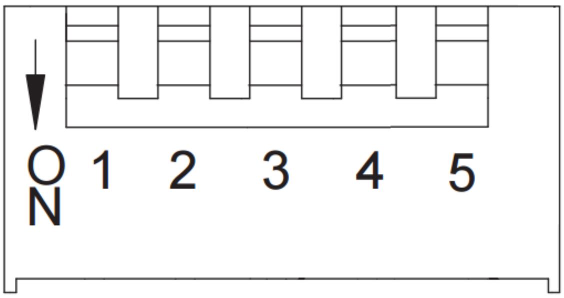

Figure 19. Function order in control selector switch block

SW	Control	Description
#1	VAM Boot 1	Control interface selection during VAM-CM power-up. "UP" – UART control active (default). "DOWN" – USB control active
#2	Reserved	
#3	Reserved	
#4	TX Disable	Disables transmitter operation of VAM-CM. "UP" – Transmitter enabled (default). "DOWN" – Transmitter disabled
#5	Reserved	

Table 17. Evaluation module control selectors

Control switches and buttons are connected in parallel with VAM control interface. When evaluation module is controlled via VAM control interface (pin header) all switches in S1000 shall be in "up" position to allow VAM control interface to disable controls.

5.2.2.3: USB Interface

USB interface is implemented with Keystone Electronics 924 B-type USB connector CN-1001. Signal order in connector is.

Pin	Control	Description
#1	VBUS	USB Bus voltage
#2	Dm	Negative data line
#3	Dp	Positive data line
#4	GND	

Table 18. USB interface signals

5.2.2.4: VAM control interface

The evaluation module control interface CN1005 includes most of VAM-CM controls. Only audio interface is separated to its own pin header. VAM control interface enables connection of the SIM, applying button and switch controls and getting the status of VAM-CM indicators.

VAM Power can also be supplied via the VAM control interface together with interface voltage Vio. With Vio user can select suitable interface voltage level between 1,65V and 5,5v. Default 3,0V Vio is supplied also in pin header and by default it is applied with jumper between pin #13 and #14. If custom Vio is applied then jumper is removed and Vio is fed in pin #14 from external source.

The VAM control interface allows VAM terminal manufacturer to use external controller to adjust VAM-CM settings. Control interface is 2 row 32 way pin header Harwin M20-9721645 which provides following controls shown in *Table 19*. Pin organization is shown in *Figure 20*.

Pin	Control	Description
#1 ... #6	VBAT	3,9V supply for VAM-CM
#7 ... #12	GND	
#13	3,0V Vio output	Power supply for Vio
#14	Vio input	Supply input for Vio. By default this is connected to pin #13
#15	Ext Vrtc supply	External backup voltage supply to enable possibility to arrange external battery backup supply for RTC and backup features. 3,3V (maximum load 1mA)
#16	VAM-CM Wake-up	VAM-CM wake-up control input “Rising edge” – Modem wake-up
#17	PWR on/off	Power on/off switching of VAM-CM. "LOW" 1 second pulse PWR on/off "HIGH" (Float) no action

Pin	Control	Description
#18	VAM_ MODEM_ OK	Modem OK
#19	Modem RST	Warm reset for VAM-CM "LOW" Warm reset for VAM-CM "HIGH" (Float) no action
#20	TTA Not OK	Modem has no GPS location or channel assignment
#21	VAM-CM Sleep	Indicates VAM-CM sleep mode status "HIGH" – Modem Active "LOW" – Modem Sleep
#22	SIM_V	SIM supply voltage output
#23	VAM_ BOOT_1	Control interface selection (UART/USB) during power-up "HIGH" (Float) UART control mode (default) "LOW" USB control mode
#24	SIM_RST	SIM Reset output
#25	VAM_ BOOT_2	Reserved for future use
#26	SIM_CLK	SIM Clock output
#27	VAM_ BOOT_3	Reserved for future use
#28	SIM_IO	SIM IO interface
#29	TX_ DISABLE	Disables VAM-CM transmitter operation "HIGH" Transmission enabled in VAM-CM (default) "LOW" Transmission disabled in VAM-CM
#30	CARD_ DETECT	SIM card inserted input

Table 19. VAM Control interface signals

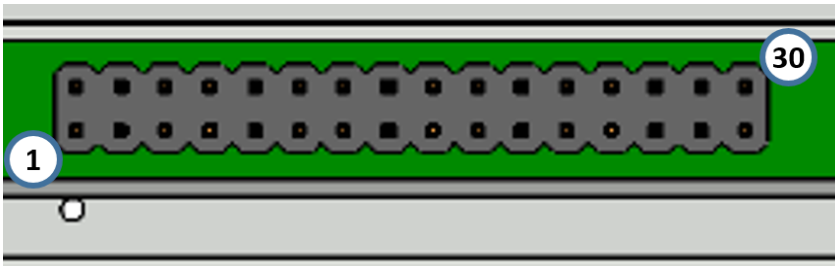

Figure 20. VAM control interface pin organization

5.2.2.5: UART Interface

UART interface is implemented with single row 6 way pin header CN1007. Applied interface is commonly used interface and allows commercially available USB/UART cable e.g. FTDI TTL-232R-3v3 adapter cable. Pin header type is Harwin M20-9730645. Signal order in pin header is shown in following *Table 20*. Pin organization is shown in *Figure 21*.

Pin	Control	Description
#1	GND	
#2	NC	
#3	NC	
#4	RXD	Received data
#5	TXD	Transmit data
#6	NC	

Table 20. UART interface signals

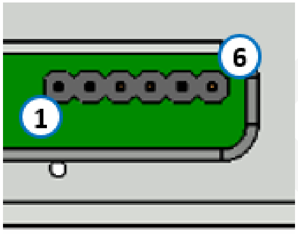

Figure 21. UART interface pin organization

5.2.2.6: Audio interfaces

The evaluation module has two audio interfaces. Analog audio interface N1000 is 3,5mm standard mono jack SJ-3523-SMT from CUI Inc providing audio in, audio out and GND. Signal order in analog audio interface is shown in *Table 21*.

Pin		Signal	Description
#1	Tip	an_Au Ext Ear	Analog audio output 0.53Vrms (load 16 ohm)
#2	Ring	an_Au Ext Mic	Analog audio input 1.5 Vpp (0dBFS, 0dB gain)
#3	Sleeve	An_Au GND	

Table 21. Analog audio interface signals

Another audio interface XCN1004 is 2 row 10 way pin header Harwin M20-9720545 which provides both analog and digital audio interfaces for VAM control. Signal order in pin header is shown in *Table 22*. Pin organization is shown in *Figure 22*.

Pin	Signal	Description
#10	**AN_AUD_EXT_MIC**	**Analog audio input**
#1	AN_AUD_EXT_MIC	Analog audio input

Pin	Signal	Description
#10	**AN_AUD_EXT_MIC**	**Analog audio input**
#2	AN_AUD_EXT_EAR	Analog audio output
#3	AGND_1	GND for analog audio
#4	AGND_1	GND for analog audio
#5	GND	GND for digital audio
#6	GND	GND for digital audio
#7	DIG_AU_DX	Digital audio transmit data
#8	DIG_AU_CLK	Digital audio clock
#9	DIG_AU_DR	Digital audio receive data
#10	DIF_AU_FS	Digital audio frame sync

Table 22. Audio pin header interface

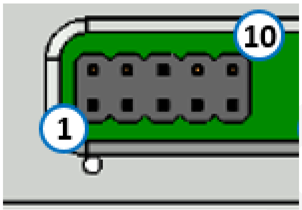

Figure 22. Audio pin header interface pin organization

5.2.2.7: SIM interface

The evaluation module SIM interface CN1006 is implemented with push-push type SIM socket Molex 47553-2001. Pin configuration of SIM interface is shown in *Table 23*.

Pin		Control	Description
#1	C1	VSIM	SIM Supply voltage
#2	C5	SIM GND	SIM GND
#3	C2	SIM RST	SIM Reset
#4	C6	NC	Not used
#5	C3	SIM CLK	SIM Clock
#6	C7	SIM IO	SIM data IO
#7	CD0	CD0	Card Detect
#8 … #10	CD1, GND0, GND1	GND	

Table 23. SIM interface signals

When applying the VAM control interface SIM card shall be removed from SIM socket CN1006 to avoid malfunctions.

5.2.2.8: Evaluation module Power supply interface

The power supply interface CN3000 for evaluation module is provided with standard DC socket Cliff Electronics DC10A. Evaluation module has internal regulators which will provide supply for VAM-CM.

Supply voltage requirement for evaluation module is 5V with 1A continuous current supply capability (4A peak). Power supply interface is protected with 2A SMD fuse. Pin configuration of power supply interface is shown in *Table 24*.

Pin		Signal	Description
#1	Center	Vsupply	+5 V, 4A peak
#2	Body	GND	GND

Table 24. ower supply interface signals

5.2.2.9: RF Interfaces

RF interfaces are connected directly to VAM-CM antenna connectors which are described in more detail in **Radio interface description** on page 18.

5.3: Control tools

The VAM control tool is based on web interface and back-end command server to interact with VAM terminals. The VAM control tool enables the use of AT-commands and AT-command sequences to control VAM terminal. Controls and DUT responses can be logged for future investigation.

The VAM control tool also contains simplified engineering mode enabling the possibility to control receiver and transmitter independently. Simplified engineering mode allows turning on the transmitter in dedicated channel and output power level as well as turning on the receiver in dedicated channel and to measure RCER and RSSI of the input signal.

Figure 23 shows a screen shot of VAM control tool log viewer. More detailed information concerning the VAM control tool can be found in *VAM Tool User Guide*.

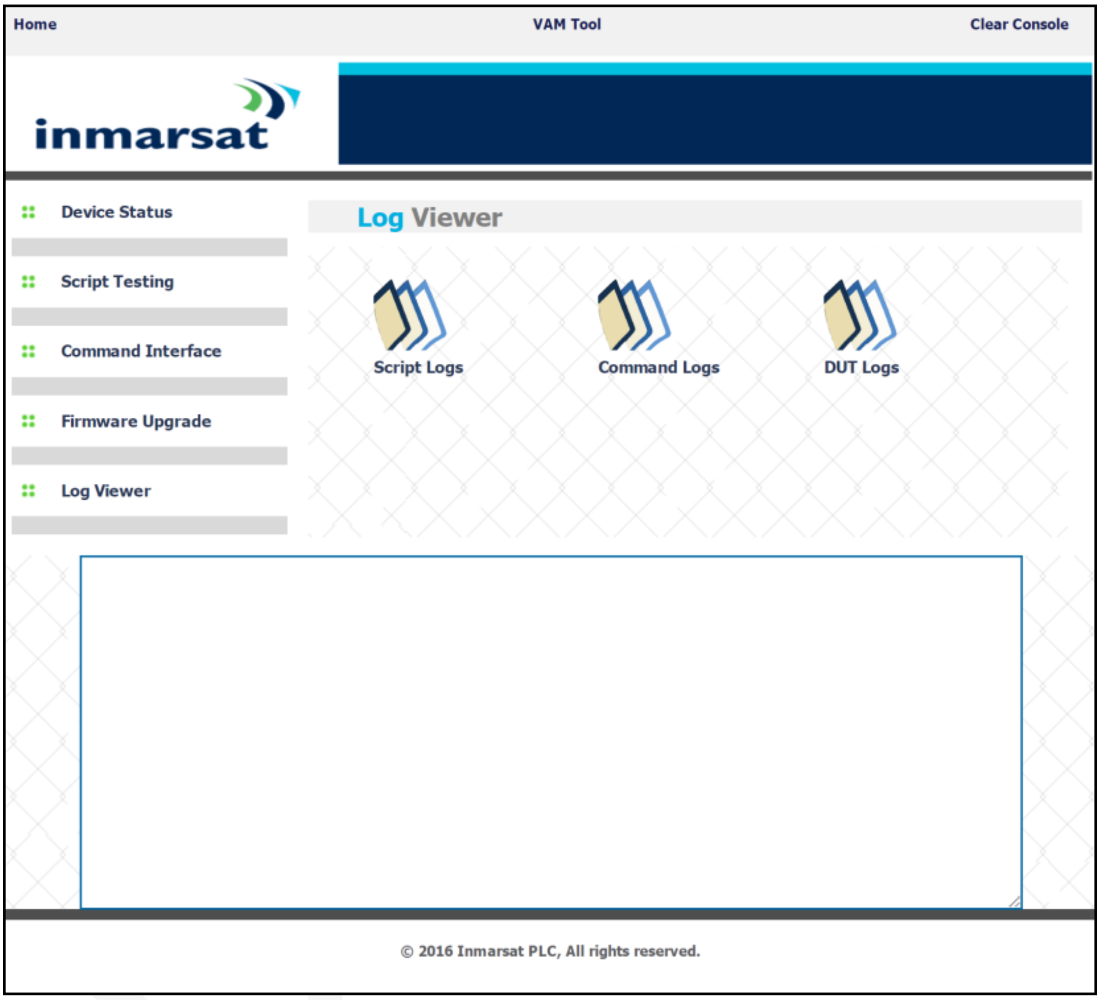

Figure 23. VAM-CM Control tool screen shot