JACOBS CST88 Certus User Guide

JACOBS CST88 Certus

Contents

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Revision History

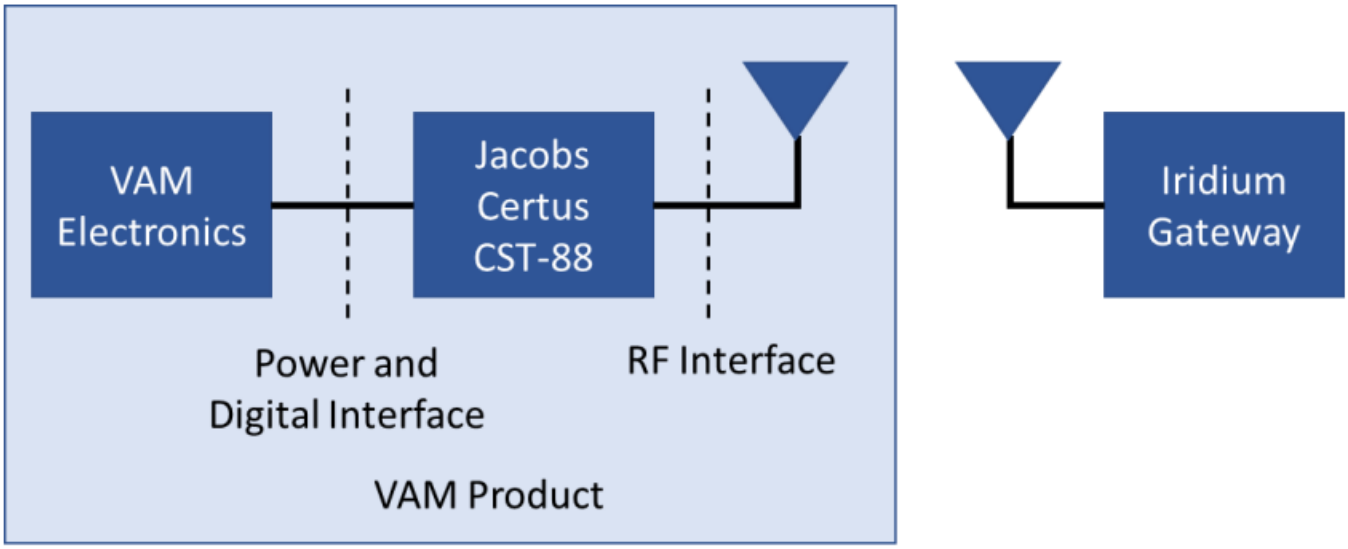
Version	Description	Date
00	Initial Release	2 March 2023

Introduction

The Jacobs CertusTM CST-88 is a transceiver designed to be used inside a Value-Added Manufacturer (VAM) product as per Figure 1-1 below. The Jacobs Certus CST-88 provides satellite messaging, IP data, and voice connectivity using Iridium's satellite constellation. Iridium's satellite services using the Jacobs Certus CST-88 are provided by Iridium Certus Service Providers (SP) to end users.
This document describes hardware specifications for the Jacobs Certus CST-88 including:

- Power and digital interfaces for connecting to VAM Electronics
- RF interfaces to a VAM furnished antenna
- Mechanical specifications for housing the transceiver in a VAM product
- Environmental specifications relating to VAM use cases

Figure 1-1: Hardware Interface Overview



Intended Audience

This document is intended to be used by a VAM that is building products incorporating the Jacobs Certus CST-88. This document focuses on hardware aspects relating to the integration of the Jacobs Certus CST-88 into a VAM product.

Reference Documents

Jacobs will provide the partner with documentation to include those listed in Table 1.2-1.

Table 1.2-1: Reference Documents

No.	**Document**	**Description**
1.	IR3142-ICD-001	Iridium Certus 9770 Software Developer Guide
2.	MX801195.STEP	Jacobs CST-88 3D CAD file in STEP file format
3.	IR5187-TRD-002	Iridium Certus CST-88 RF Path Performance Technical Require ments
4.	tbd	Jacobs Certus CST-88 – EU Declaration of Conformity

Abbreviations

Term	Description
CE	Conformité Européene
DTMF	Dual Tone Multi Frequency
EIRP	Equivalent Isotropic Radiated Power
FCC	Federal Communications Commission
GPIO	General Purpose Input/Output
GND	Ground
IC	Industry Canada
RH	Relative Humidity
SIM	Subscriber Indentity Module
SD Card	Secure Digital (non-volatile memory card)
SP	Service Provider
SPI	Serial Peripheral Interface
UART	Universal Asynchronous Receiver Transmitter
VAM	Value-Added Manufacturer
VSWR	Voltage Standing Wave Ratio

Digital Interface

The digital interface to the Jacobs Certus CST-88 consists of the following interfaces:

- Four UARTs
    - UART_A: Command and control functionality
    - UART_B: Transfer of user data
    - UART_C: Reserved
    - UART_D: Reserved
- I2S bus for transfer of digital audio samples used in voice calls
- SPI bus for Jacobs diagnostics to assist VAM troubleshooting
- Several GPIO lines for status and control
- Power input
- Ground return
- SIM card interface

Digital Connector

The digital connector on the Jacobs Certus CST-88 uses a socket connector (Samtec part number SFM-125-01-L D). This connector provides a 1.27 mm pitch vertical socket for a board-to-board connection. The connector is intended to be used with a mating header connector on a VAM product. The recommended mating connector is a

Samtec FW-25 02-LD-sh-ph series connector (TH tail height=0.075”, with stacker height sh and post height ph based on customer’s mechanical integration).

Pin Locations

The Jacobs Certus CST-88’s digital connector is a 50-pin connector with pin numbering that does not follow Samtec’s drawing for its socket connector. The location of pins 1 and 2 are shown in the figure below, as seen looking at the top surface of the Jacobs Certus CST-88. Pinout assignments on the digital connector are listed in Figure 2.2-1.

Figure 2.2-1: Pinout Location (Top Surface View)

Table 2.2-1: Digital Connector Pinout Assignments

Pin No.	**Signal Name**	**Pin No.**	**Signal Name**
1.	EXT_PWR	**26.**	SIM_IO
2.	EXT_PWR	**27.**	SIM_EN
3.	EXT_PWR	**28.**	SIM_PD
4.	EXT_PWR	**29.**	SIM_RST
5.	GND	**30.**	SIM_VCC_SEL
6.	GND	**31.**	WAKE_XCVR_IN
7.	GND	**32.**	WAKE_XCVR_OUT
8.	GND	**33.**	ENABLE
9.	UART_A_XCVR_RX	**34.**	RESET
10.	UART_A_XCVR_TX	**35.**	PWR_GOOD
11.	UART_B_XCVR_RX	**36.**	BOOTED
12.	UART_B_XCVR_TX	**37.**	XMIT_GATE
13.	UART_C_XCVR_RX	**38.**	SPI_SCLK
14.	UART_C_XCVR_TX	**39.**	GND
15.	UART_D_XCVR_RX	**40.**	GND
16.	UART_D_XCVR_TX	**41.**	SPI_COPI
17.	I2S_MIC_SD	**42.**	SPI_CIPO
18.	I2S_SPKR_SD	**43.**	SPI_CS0
19.	Reserved	**44.**	SPI_CS1
20.	I2S_SPKR_WS	**45.**	RESERVED
21.	Reserved	**46.**	RESERVED
22.	I2S_SPKR_SCK	**47.**	RESERVED
23.	GND	**48.**	RESERVED
24.	GND	**49.**	RESERVED
25.	SIM_CLK	**50.**	RESERVED

Pinout Descriptions

Figure 2.3-1 identifies the pinout assignments on the digital connector along with the signal direction and the value of any internal pull-up or pull-down resistors if applicable. The pull-up or pull-down resistor forces the signal into a known state when power is applied and before the transceiver boots.

Figure 2.3.1: Digital Connector Pinout Description

Pin No.	Signal Name	Signal Direction	Pull-up/Pull-down (ohms)	Signal Description
1.	EXT_PWR	–	–	Power supply input
2.	EXT_PWR	–	–	Power supply input
3.	EXT_PWR	–	–	Power supply input
4.	EXT_PWR	–	–	Power supply input
5.	GND	–	–	Power supply retur n
6.	GND	–	–	Power supply retur n
7.	GND	–	–	Power supply retur n
8.	GND	–	–	Power supply retur n
9.	UART_A_XCVR_RX	Input	100k pull-up	Serial port A data r eceive
10.	UART_A_XCVR_TX	Output	100k pull-up	Serial port A data t ransmit
11.	UART_B_XCVR_RX	Input	100k pull-up	Serial port B data r eceive
12.	UART_B_XCVR_TX	Output	100k pull-up	Serial port B data t ransmit
13.	UART_C_XCVR_RX	Iput	100k pull-up	Serial port C data r eceive
14.	UART_C_XCVR_TX	Output	100k pull-up	Serial port C data t ransmit
15.	UART_D_XCVR_RX	Input	100k pull-up	Serial port D data r eceive
16.	UART_D_XCVR_TX	Output	100k pull-up	Serial port D data t ransmit
17.	I2S_MIC_SD	Input	100k pull-up	Audio input data
18.	I2S_SPKR_SD	Output	–	Audio output data

19.	Reserved	Output	–	No connect
20.	I2S_SPKR_WS	Output	–	I2S word select
21.	Reserved	Output	–	No connect
22.	I2S_SPKR_SCK	Output	–	I2S primary clock
23.	GND	–	–	Power supply return
24.	GND	–	–	Power supply return
25.	SIM_CLK	Output	–	SIM clock
26.	SIM_IO	Input/Output	–	SIM card data
27.	SIM_EN	Output	100k pull-down	Power supply control for SIM chip activation enable High = enable
28.	SIM_PD	Input	100k pull-down	SIM presence detect High = SIM card present
29.	SIM_RST	Output	–	SIM Interface reset Low = Reset
30.	SIM_VCC_SEL	Output	100k pull-down	SIM card voltage select High = 3.0 V SIM Low = 1.8 V SIM
31.	WAKE_XCVR_IN	Input	100k pull-down	Wakeup request High= wakeup request
32.	WAKE_XCVR_OUT	Output	100k pull-down	Wakeup state status High = awake
33.	ENABLE	Input	100k pull-down	Power enable control line High= enable for operation
34.	RESET	Input	100k pull-down	Reset control line

35.	PWR_GOOD	Output	–	Signal is connected to a 3.3 V regulator through a series resistor when good power is present on EXT_PWR
36.	Booted	Output	100k pull-down	Processor has booted and UART_A is active
37.	XMIT_GATE	Output	100k pull-down	Transmitter active High = transmitting
38.	SPI_SCLK	Output	–	SPI serial clock
39.	GND	–	–	Power supply return
40.	GND	–	–	Power supply return
41.	SPI_COPI	Output	–	SPI Controller input peripheral output
42.	SPI_CIPO	Input	100k pull-up	SPI Controller input peripheral output
43.	SPI_CS0	Output	100k pull-up	External SD card chip select
44.	SPI_CS1	Output	100k pull-up	External ethernet IC chip select
45.	RESERVED	–	–	No Connect
46.	RESERVED	–	–	No Connect
47.	RESERVED	–	–	No Connect
48.	RESERVED	–	–	No Connect
49.	RESERVED	–	–	No Connect
50.	RESERVED	–	–	No Connect

Digital Input/Output

The digital outputs and inputs on the Jacobs Certus 9770 are 3.3 V CMOS compatible. Figure 2.4-1 contains the electrical specifications for the digital inputs and outputs. The 3.3 V CMOS specifications are applicable to all signals on the digital connector except for the EXT_PWR, GND and RESERVED pins.

Figure 2.4-1: Digital Input/Output Specifications

Parameter	Symbol	Min	Typical	Max	Unit
Input High Voltage	VIH	2.0			V
Input Low Voltage	VIL			0.8	V
Output High Voltage	VOH	2.9			V
Output Low Voltage	VOL			0.4	V
Output Current Low Level	IOL			-2	mA
Output Current High Level	IOH			2	mA
Absolute Maximum Input Voltage (all cases)	Vmax			3.6	V
Absolute Minimum Input Voltage (all cases)	Vmin	-0.3			V

ESD Protection

The Jacobs Certus CST-88 transceiver provides protection of its digital connections against ESD at level 1 of ESD standard EN 61000-4-2:2009, using a human body model direct-contact discharge of 2 kV.

Power Supply

The Jacobs Certus CST-88 transceiver has a single voltage power supply input (EXT_PWR). EXT_PWR accepts input voltages of +12 VDC +/- 2 V. To mitigate spurious emissions and self- interference, the VAM power supply should not have any switching frequencies with harmonics that lie in Jacobs's transmit or receive bands. The Jacobs Certus CST-88's input current varies depending on its operational mode. At all times, as the Jacobs Certus CST-88 current demand varies, the VAM power supply must keep EXT_PWR from deviating outside its permitted voltage range. The maximum operational input current for the Jacobs Certus CST-88 in stable operation is 3 A.
Note: The Jacobs Certus CST-88's IEC 62368-1 safety test report assumes that the power source feeding the transceiver complies with classes ES1 and PS2.
Before it stabilizes, on startup and when ENABLE is activated, the Jacobs Certus CST-88 can briefly draw more current than its operational peak current. The design of the VAM power supply feeding EXT_PWR needs to consider the effect of these current transients; possibly by inserting a current limiter between the power supply and the Jacobs Certus CST-88.
In addition, if the VAM power supply uses a short circuit detector, the detector should have an appropriate trip time to avoid being triggered by these current transients.

Power Consumption

Figure 2.7-1 provides typical power consumptions for the Jacobs Certus CST-88. The power consumption figures in the table assume that the Jacobs Certus CST-88 has clear view of the sky for tracking all available Jacobs satellites. The Jacobs Certus CST-88's power consumption varies based on factors such as:

- Sky view that can affect signal power if blockages are present
- Satellite position in sky that affects transmitter power through its use of closed-loop
- Power control
- Manufacturing variations
- Temperature

In cases where power consumption is important, a VAM needs to consider worst case power consumption scenarios.

Figure 2.7-1: Typical Power Consumption

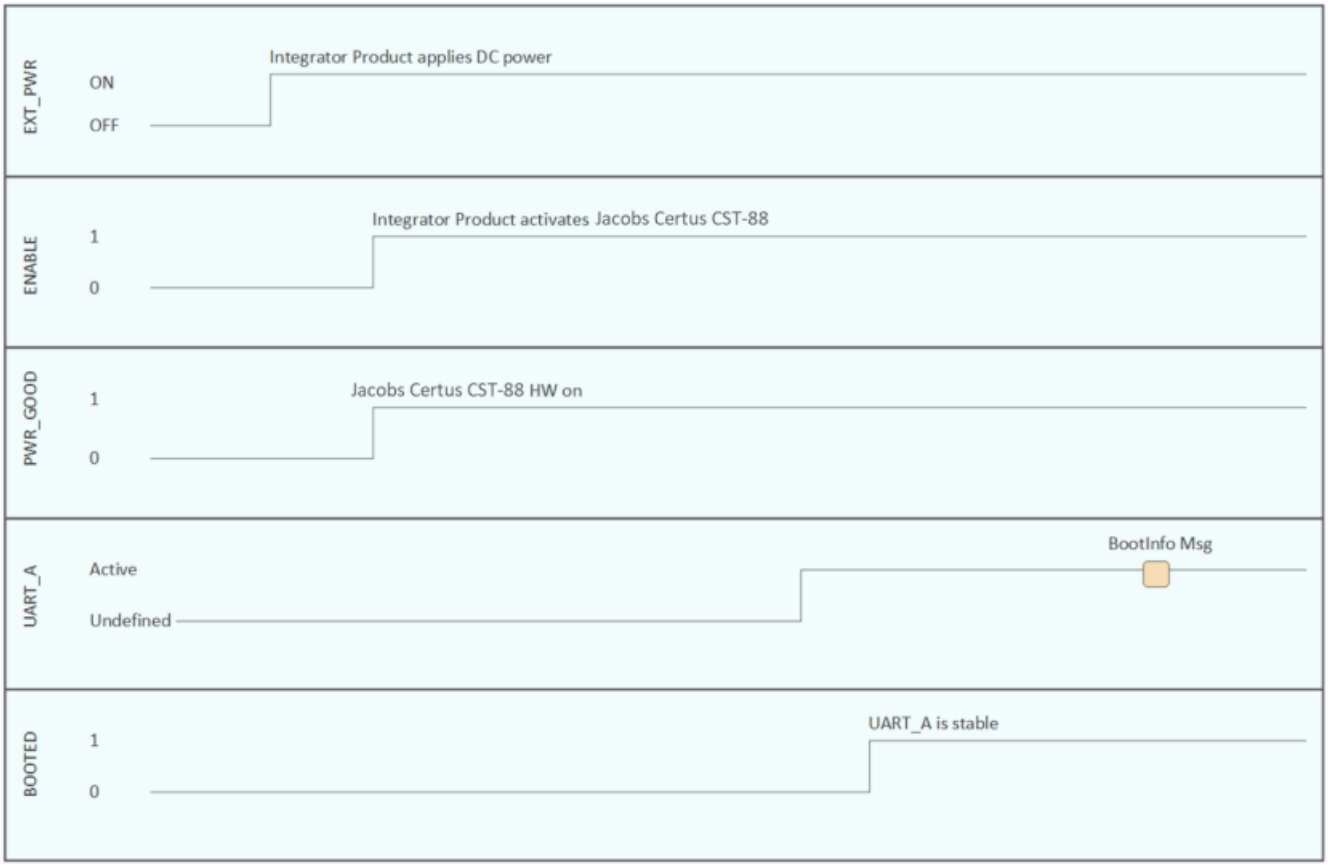
DC Power Consumption (At 12V input & at 25C)	**Typcial Value**
Full transmit (88 kb/s) and receive (88 kb/s) averaged over time in an open sk y environment	10-35W
Idle (See section 2.14)	60mW
ENABLE inactive	1mW

The typical power consumption at full transmit and receive in Table 2.7-1 assumes nominal operation in an open sky environment where the Jacobs Certus CST-88's output RF power varies due to the Jacobs power control loop.
The Jacobs Certus CST-88's power consumption increases as its temperature increases. At 70ºC ambient, its maximum peak power consumption at full transmit and full receive is 35 W.

Power On Control

The power up timing sequence for the Jacobs Certus CST-88 is illustrated in Figure 2.8-1.

Figure 2.8-1: Power On Timing Sequence



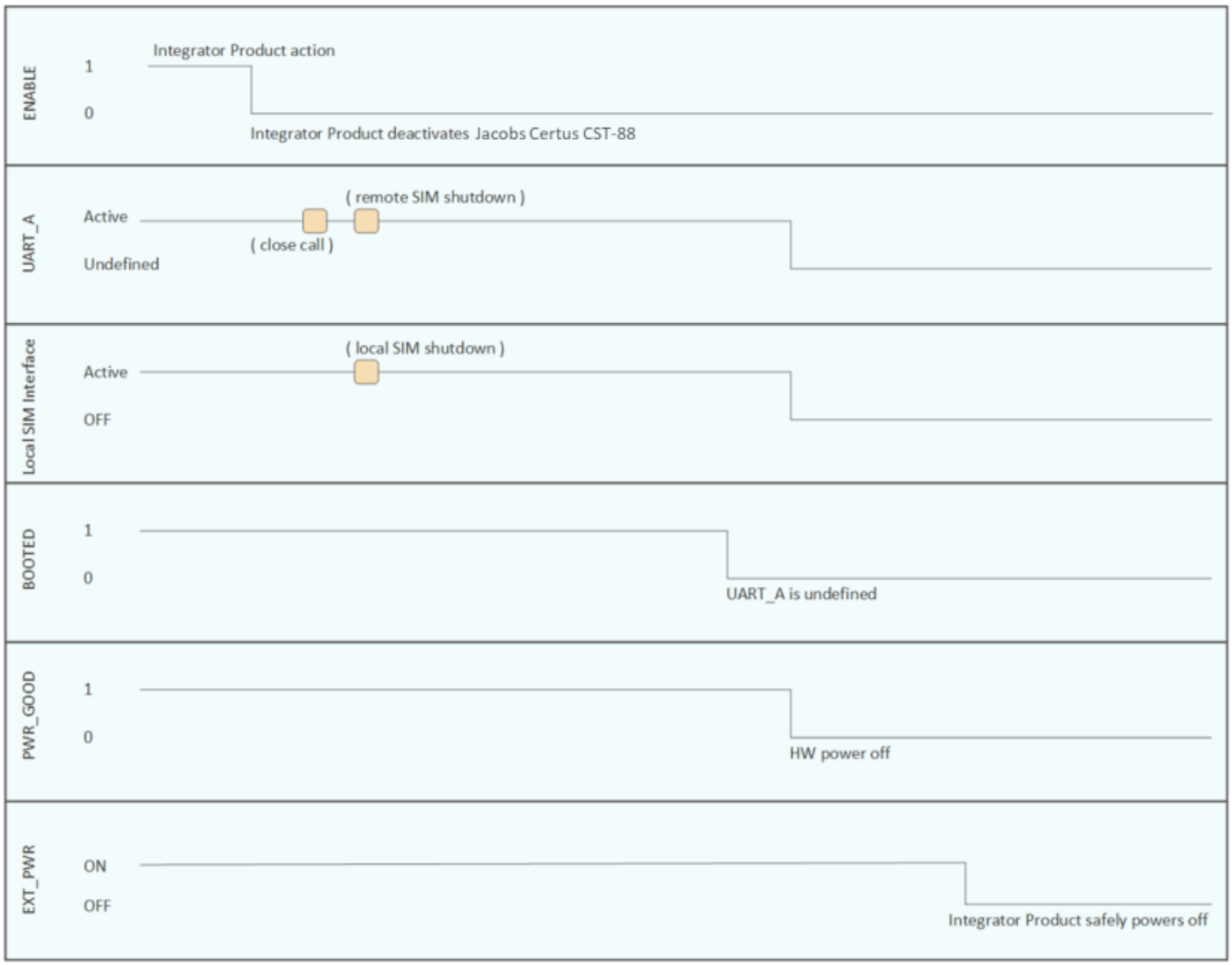
After a VAM product applies valid and stable EXT_PWR, it can activate the Jacobs Certus CST-88 by asserting the ENABLE signal. In response to ENABLE being activated, the Jacobs Certus CST-88 raises PWR_GOOD when its internal regulator stabilizes and then starts its boot sequence. Once, the Jacobs Certus CST-88 has booted it activates the BOOTED signal.
RESET can be left floating, or it can be controlled by a VAM product during the power-on process. If RESET is

held low during power-on, it simply holds off the software booting process until the RESET line is released. After power-on and boot-up, the Jacobs Certus CST-88 activates its main serial control interface (UART_A) at 230400 baud, leaving the other serial interfaces UART_B, UART_C and UART_D disabled until they are configured as per Reference 1. UART_A initialization is completed approximately 50 ms prior to activation of BOOTED which allows the serial transmit data lines to stabilize.

Power Off Control

Figure 2.9-1 illustrates the timing sequence for a safe and orderly shutdown of the Jacobs Certus CST-88.

Figure 2.9-1: Power Off Timing Sequence



Before a VAM product removes EXT_PWR, it must release the ENABLE line or drive it low. When the Jacobs Certus CST88 detects that ENABLE is inactive, it performs an orderly shutdown procedure and makes BOOTED inactive. After making BOOTED inactive, the Jacobs Certus CST-88 disables UART_A and makes PWR_GOOD inactive approximately 50 ms later. The entire orderly shutdown procedure typically takes around 100 ms, but it can take up to 2 seconds if SIM operations are required or pending.
EXT_PWR should only be removed from the Jacobs Certus CST-88 after PWR_GOOD goes inactive. If EXT_PWR is removed during the orderly shutdown procedure, the Jacobs Certus CST-88's behavior is undefined and internal data may become corrupted.
The use of the RESET signal does not allow for an orderly and safe shutdown of the Jacobs Certus CST-88.

Phantom Powering

It may be possible to encounter conditions where a VAM product removes EXT_PWR from the Jacobs Certus CST 88 but some of the VAM electronics remain active. If this condition is possible, a VAM product should be designed to avoid phantom powering the Jacobs Certus CST-88. A recommendation to avoid phantom powering

is to use PWR_GOOD as a control signal to disconnect signals from Jacobs Certus CST-88 using transition gates.

Serial Ports

The Jacobs Certus CST-88 has four serial UART interfaces.
UART_A provides a serial interface running at 230400 baud with software flow control. UART A provides the main software control interface. Refer to Reference 1 for details. UART_A is intended to be connected directly to the VAM application and not exposed to the end user outside a VAM product.
The three other UARTs (UART_B, UART_C and UART_D) are disabled on boot. UART_B can be configured to operate at baud rates from 19200 to 230400, as described in Reference 1. UART_B supports software flow control and provides data services for transferring user data. Refer to Reference 1 for more details on data services. UART_C and UART_D are reserved.

Digital Audio Interface

The Jacobs Certus CST-88 has a digital audio interface that supports up two independent voice lines.
Digital audio samples for voice calls are transferred over two I2S data lines: I2S_MIC_SD for digital audio going to the Jacobs Gateway and I2S_SPKR_SD for digital audio coming from the Jacobs Gateway. Each data line operates at a serial clock transfer speed of 512 kHz passing audio samples using a common clock (I2S_SPKR_SCK). Each interface also transfers audio samples using a common select signal (I2S_SPKR_WS) at a rate of 8000 samples per second and 16-bit samples.
Within each I2S data line, two ‘audio lines’ are supported using the left and right channels of the I2S interface. Digital samples for audio line #1 are transferred using the I2S_SPKR_WS low word. Digital samples for audio line #2 are transferred using the I2S_SPKR_WS high word.

SIM Interface

The Jacobs Certus CST-88 supports two SIM interface configurations:

- Local SIM
- Remote SIM

The local SIM uses hardware signals on the digital connector. The remote SIM does not require any dedicated hardware signals and is implemented in software.
In the local SIM configuration, the SIM card is part of the VAM electronics, typically located near the Jacobs Certus CST88. As digital signals on the Jacobs Certus CST-88’s digital connector use 3.3 V compatible logic levels, a VAM product requires an external SIM level converter such as the Fairchild FLP4555 to support both 3 V and 1.8 V SIM cards. The level converter also ensures that SIM signals are inactive when PWR_GOOD is not asserted. VAM products must also provide any required ESD protection for SIM input and outputs on the Jacobs Certus CST-88 as the transceiver has limited ESD protection.
When the local SIM is used, SIM_PD must be active when the Jacobs Certus CST-88 powers up the SIM. If SIM PD goes inactive when the Jacobs Certus CST-88 is active, the SIM is declared invalid, and the Jacobs Certus CST-88 must be reset for the SIM to be recognized.

The remote SIM configuration is described in Reference 1. When the remote SIM configuration is used, all local SIM signals on the Jacobs Certus CST-88 should be left disconnected.

Power Saving Features

The Jacobs Certus CST-88 supports power saving features used to reduce power consumption when the transceiver is idle, which happens when the transceiver is not transferring user data or in a voice call. When the Jacobs Certus CST-88 is saving power, it monitors the Iridium network for “ring alerts” and turns off all unnecessary clocks, including those used to support serial communications with a VAM product.

Optionally, a VAM product may save further power by disabling the serial interface using two extra hardware signals: WAKE_XCVR_IN and WAKE_XCVR_OUT.
A VAM product asserts WAKE_XCVR_IN to request the Jacobs Certus CST-88 to turn off the serial interface. When the Jacobs Certus CST-88 decides that is safe to switch, it disables its UARTs and asserts WAKE_XCVR_OUT. Once a VAM product detects that WAKE_XCVR_OUT is asserted, it can turn off its own UARTs to save power as well. When a VAM product wants to wake up the Jacobs Certus CST-88, it must de-assert WAKE_XCVR_IN. When the Jacobs Certus CST-88 detects that WAKE_XCVR_IN is not active, it de-asserts WAKE_XCVR_OUT. Once the Jacobs Certus CST-88 de-asserts WAKE_XCVR_OUT it is ready to communicate with a VAM product.
Similarly, when the Jacobs Certus CST-88 wants to signal a VAM product that it needs to wake-up, it enables it UARTS and asserts WAKE_XCVR_OUT. Once WAKE_XCVR_OUT is asserted, a VAM product must enable its UARTs, de-assert WAKE_XCVR_IN and be prepared to respond appropriately to all Jacobs Certus CST-88 commands on UART_A within 5 seconds.

Transmit Indicator

The Jacobs Certus CST-88 provides a digital output signal (XMIT_GATE) that indicates when the transceiver is transmitting on the Jacobs network. A VAM can optionally use XMIT_GATE to control its own RF transmit/receive switches in its product. Lead and lag timing for the XMIT_GATE relative to the transmitter activation can be configured by software. Refer to Reference 1 for details.

Diagnostic Interface

The Jacobs Certus CST-88 provides a diagnostic mode that outputs Iridium proprietary data that Jacobs can use to assist in VAM troubleshooting. The diagnostic mode uses the SPI interface on the Jacobs Certus CST-88. Diagnostic data can be sent to two separate destinations determined by the SPI chip select: SD card (SPI_CS0) and ethernet trace outputs (SPI_CS1). Only one diagnostic interface can be active at one time. Jacobs must provide an authentication key to the VAM in order to use the diagnostic mode.
From a VAM's perspective, the Jacobs Certus CST-88 diagnostic mode removes a VAM application's need to log and collect Jacobs proprietary diagnostic data. From an Jacobs's perspective, the diagnostic mode is invaluable as it provides Jacobs with VAM-independent diagnostic information. The Jacobs Certus CST-88 generates two types of diagnostic data:

- Non real time diagnostic logs
- Real time trace logs

Real time trace logs use ethernet trace output. In order to support ethernet log captures, a VAM product must have an ethernet IC compatible with the Microchip ENC28J60. This is the same IC that is used in the Jacobs Certus CST-88 Development Kit. VAM support for ethernet trace logs is strongly recommended, at least in early product development phases. The real time ethernet trace allows a VAM to relatively easily connect the VAM product to test computers with an ethernet connection.
Non real time diagnostic logs can be stored to the SD card. The SD card is useful for both field trials and engineering lab development. The SD card eliminates the need for special cables and diagnostic logging equipment to capture diagnostic information. In order for Jacobs to better support VAM field trials, a VAM product should support a microSD holder that connects to the Jacobs Certus' SPI interface using SPI_CS0. The SD holder does not need to be installed in every VAM production unit, but a microSD holder capability should be available for VAM testing and field trials. Depending on how a VAM product is used, the microSD card holder may need to be located where end users or Jacobs Service Providers (SPs) can retrieve the SD card after testing is complete.

RF Interface

The Jacobs Certus CST-88 has a dedicated RF connector that provides a connection to an external passive antenna.

RF Connector Type

The Jacobs Certus CST-88 has a right-angle jack, MMCX 50-ohm RF connector (Samtec part number MMCX-J-P H-RATH1). The RF connector is located on the opposite end of the transceiver from the digital connector.

General RF Specifications

The general RF interface requirements for the Jacobs Certus CST-88 are summarized in Figure 3.2-1 below. All radiated values assume a compliant antenna and cable system (see Reference 3).

Figure 3.2-1: General RF Parameters

Parameters	**Value**
Frequency Range	1616 MHz to 1626.5 MHz
Transmit Frequecy Range	1616 MHz to 1626 MHz
Receive Frequency Range	1616 MHz to 1626.5 MHz
Duplexing Method	TDMA (Time Division Multiple Access)
Input/Output Impedance	50 Ω
Transmit RF Burst Duration	8.3-33.1 ms
Transmit RF Burst Interval	90 ms

Conducted RF Interface

The Jacobs Certus CST-88's RF output power at its connector varies during normal operating conditions as it is subject to dynamic transmitter power control by the Iridium network. As such, the conducted RF power average (measured at the RF connector) across the burst may range between +24 dBm and +40 dBm, depending on the signal type, link conditions and dynamic power control level. Conducted RF peak power may be up to 6 dB higher than the average RF power measured over a transmit burst.
The absolute maximum RF input into the Jacobs Certus CST-88 should not exceed +5 dBm; otherwise, damage to the Jacobs Certus CST-88 is possible.

RF Path Considerations

A VAM product's antenna and associated RF cabling must meet the RF Path requirements defined in Reference 3. For cases when the combined RF path performance including antenna gain and RF cable loss exceeds the specifications in Reference 3, a VAM product may be able to back-off the transmit power to reduce power consumption. Refer to Reference 1 for more details on setting the transmitter power back-off between 0 to 2 dB.
For safety reasons, the RF connector on the Jacobs Certus CST-88 should not be directly connected to an external antenna cable or cable distribution system.
IEC62368-1 safety standard requires that users are protected against high voltages that might appear on these cables.
This can be achieved either by inserting a high voltage isolating capacitor in series with the signal or by grounding the shield of the coaxial cable. The Jacobs Certus CST-88's RF connector has limited voltage capacity; therefore, protection needs to be provided by a VAM product. Developers are encouraged to review the IEC62368-1 standard for additional details.

ESD Protection

The Jacobs Certus CST-88 transceiver provides protection of its RF connection against ESD at level 4 of ESD standard EN 61000-4-2:2009, using a human body model direct-contact discharge of 8 kV.

Mechanical Specifications

The following section describes the mechanical specification for the Jacobs Certus CST-88

Figure 4-1: Jacobs Certus CST-88 Front and Back Views

Size & Mass

The Jacobs Certus CST-88 overall dimensions are 6.5”L x 4.5”W x 0.75”H and its mass is 1.075 lbs

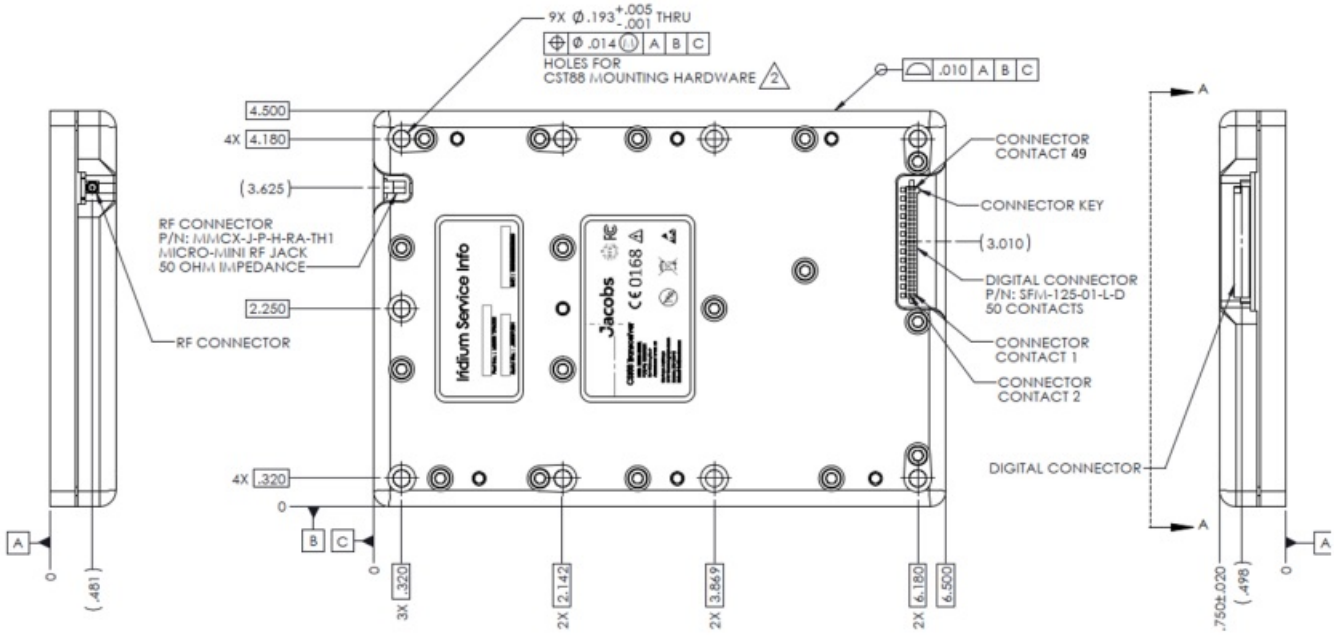
Enclosure Material

The enclosure material is an Aluminum 6061-T6511 Alloy with a RoHs Compliant clear chemical film finish.

Mechanical Drawing

Figure 4.3-1 shows the mechanical dimensions of the Jacobs Certus CST-88. CAD files for the Jacobs Certus CST 88 are also available in a STEP file as per Reference 2.

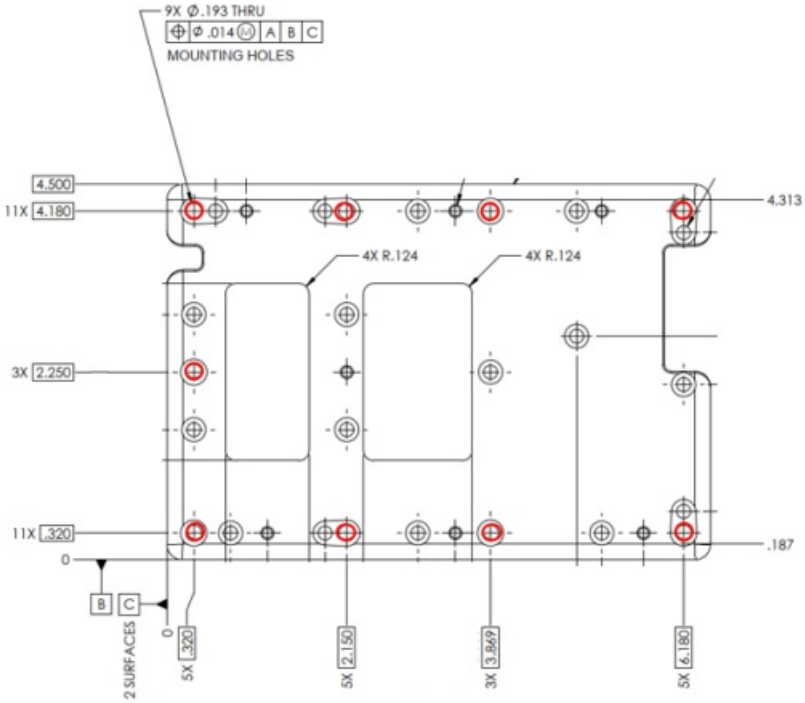
Figure 4.3-1: Jacobs Certus CST-88 Mechanical Drawing



Mounting Considerations

The Jacobs Certus CST-88 has nine mounting holes highlighed red in Figure 4.4-1 with clearance for #8-32 bolts (McMaster 93802A645 or similar) that can be used to secure the transceiver to a VAM product. The Jacobs Certus CST88 should be assembled into a VAM product securing the transceiver to the VAM's enclosure. The VAM product's mating connector (or PCA with mating connector) should be pushed straight down onto the transceiver's socket connector and the mating assembly secured while ensuring not to rotate or twist the connector interface.

Figure 4.4-1: Jacobs Certus CST-88 Mounting Hole Drawing



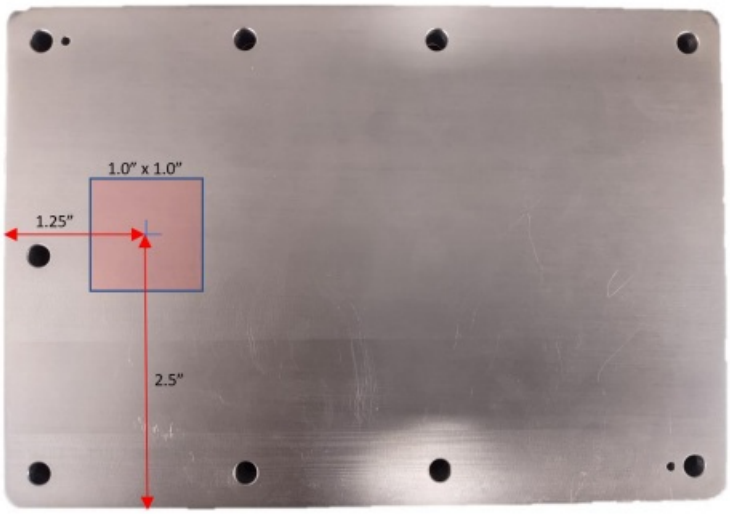
Grounding

Ground pins on the Jacobs Certus CST-88 digital connector are the intended return path for all return currents. As such, although the Jacobs Certus CST-88's metal enclosure is also electrically connected to a ground, it is recommended that all high current ground returns only flow through the ground pins on the digital connector

Thermal Management

The Jacobs Certus CST-88 has an aluminum die cast enclosure which provides a passive thermal heat sink path that is designed to conduct and radiate heat from its bottom surface to a VAM product. Figure 4.6-1 illustrates the location on the Jacobs Certus CST-88's power amplifier where the dominate heat is generated. At a minimum, it is recommended that heat sinks on a VAM product contact the Jacobs Certus CST-88 at this location. Depending on a VAM product design and use case scenarios, larger heat sink contact zones may be required.

Figure 4.6-1: Primary Heat Source location



The power consumed by the Jacobs Certus CST-88 is either converted to heat or radiated out the antenna when the transceiver is transmitting. In full transmit and receive modes, the Jacobs Certus CST-88 typically radiates 3.6W on average out the antenna, and the remaining power consumed by the transceiver generates heat. A VAM product is responsible for dissipating enough heat from the Jacobs Certus CST-88 into the ambient environment to ensure that both the Jacobs Certus CST-88's ambient and case temperature does not exceed the temperatures in Table 4.6-1. If the Jacobs Certus CST-88 gets too hot, its thermal protection circuitry can shut the transceiver off and put it into a fault mode. The Jacobs Certus CST-88's thermal protection circuitry is included for failsafe operation. A VAM product cannot rely on this protection circuitry to ensure that that maximum case temperature is met. Once the Jacobs Certus CST-88 enters a fault mode, a reset or power up is required to recover. Reference 1 describes how to read the status of internal temperature sensors and the notifications that are generated if the Jacobs Certus CST-88 goes into fault mode.

Figure 4.6-1: Thermal Management Temperature Specifications

Parameters	**Value**
Maximum Case Temperature	75°C
Maximum Ambient Temperature	70°C
*When transmitting or when ambient temperatures exceed 60°C, the Jacobs Certus CST-88's enclosure can be hot to the touch. Avoid direct contact with the transceiver in order to avoid burns.	

Environmental

The environmental specifications for the Jacobs Certus CST-88 are summarized in Table 5-1.

Figure 5-1: Environmental Specifications

Parameters	Value
Operating Temperature Range	-40ºC to + 70ºC
Operating Humidity Range	≤ 95% RH
Storage Temperature Range	-40ºC to + 85ºC
Storage Humidity Range	≤ 93% RH
Operational Vibration	• 0.02 g^2/Hz from 10 Hz to 40 Hz, 40 Hz to 500 Hz dropping 6 dB per octave • 0.96 m^2/s^3 from 5 Hz to 20 Hz, 21 Hz to 500 Hz dropping 3 dB per octave
Shock	• 10 G peak shock over a period of 11 ms • 3 shocks in 3 perpendicular orientations

Regulatory Approvals

The Jacobs Certus CST-88 transceiver is a regulatory approved module (also referred to as device or equipment within this section) that can be fitted within in a VAM product (or host device). The VAM is responsible for providing the appropriate external connections to ensure that the host device meets all pertinent regulatory requirements (for example, CE, FCC, and IC) and is sold as a regulatory certified product. It is the responsibility of the VAM to ensure that the VAM product meets all regulatory requirements.
The VAM is responsible for determining the required host regulatory testing and/or obtaining the required host approvals for compliance. If needed please contact the applicant/grantee (Jacobs Technology) regarding detailed information on how to set up the device for any compliance testing for which the VAM is responsible, per KDB 996369 D04.

The Jacobs Certus CST-88 has been tested to the regulatory and technical certifications shown in Table 6-1.

Figure 6-1: Regulatory & Technical Certifications

Regulatory Approvals	Radio Tests	EMC Tests	Electrical/Mechanical/ Operational Safety Tests
EU (Red)	• ETSI EN 301 441 V2.1.1 (2016-06)	• ETSI EN 301 489-1 V2.2.1 (2019-03) • ETSI EN 301 489-20 V 2.1.1 (2019-04)	• IEC 62638-1:2014
FCC	• FCC 47 CFR Part 2: 2018 • FCC 47 CFR Part 25: 2018	• FCC 47 CFR Part 15B: 2018	
Industry Canada	• RSS170 Issue 3 (2015-07) • ISEDC RSS-GEN Issue 5 + A1 (2019-03)	• ISEDC RSS-GEN Issue 5 + A1 (2019-03)	

Unauthorized Changes

Jacobs has not approved any changes or modifications to the device by the user. Any changes or modifications could void the user's authority to operate the equipment.

Radio Interference

This device will comply with Part 15 of the FCC Rules and Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.
Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropic radiated power (EIRP) is not more than that necessary for successful communication.

RF Exposure

This equipment complies with FCC and IC radiation exposure limits set forth for an uncontrolled environment. The antenna should be installed and operated with minimum distance of 30 cm between the radiator and your body. Antenna gain must be below: 3.0 dBi. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

FCC Class B Digital Device Notice

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

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

Labeling Requirements for the Host Device

The host device shall be properly labelled to identify the modules within the host device. The certification label of the module shall be clearly visible at all times when installed in the host device, otherwise the host device must be labelled to display the FCC ID and IC of the module, preceded by the words “Contains transmitter module”, or the word “Contains”, or similar wording expressing the same meaning, as follows:

- Contains FCC ID: 2A99V-CST88
- Contains IC: 30125-CST88

  OR
- Contains transmitter module FCC ID: 2A99V-CST88
- Contains transmitter module IC: 30125-CST88

CAN ICES-3 (B)/NMB-3 (B)

This Class B digital apparatus complies with Canadian ICES-003.

EU Declaration of Conformity

The EU Declaration of Conformity is available as mentioned in Reference 4.

Jacobs

Documents / Resources

	JACOBS CST88 Certus [pdf] User Guide CST88 Certus, CST88, Certus

References

- User Manual