

DRAFT 8-1-2019

Technical Brief Aclara Radio Module (101-2017-025) Implementation Requirements Y20980-TEB Rev. A



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FCC/ISED Compliance

This product/device has been tested and certified to be in compliance with all appropriate requirements of both the FCC and ISED.

Any changes or modification to this product/device, or the use of any antenna other than the one provided by or authorized with expressed written approval by Aclara Technologies LLC may void the user's authority to operate this product/device.

This product/device and/or its antenna must be fixed-mounted on indoor or outdoor permanent structure(s) providing a separation distance of greater than 20 cm from all persons during normal operation. This device is not designed (and it has no external connection) to operate in conjunction with any other antennas or transmitters. No other operating instructions for satisfying RF exposure compliance are needed.

This product/device has been tested and calibrated at the factory. It has no user adjustable controls and can only be adjusted by authorized, trained personnel.

Conformité FCC/ISDE

Cet équipement a été testé et il est conforme à toutes les exigences appropriées de la FCC et de l'ISDE.

Tout changement ou toute modification à cet appareil, ou l'emploi de n'importe quelle antenne autre que celle fournie par ou autorisée sous l'accord exprès donné par écrit d'Aclara Technologies LLC peut annuler l'autorisation d'utiliser de cet appareil.

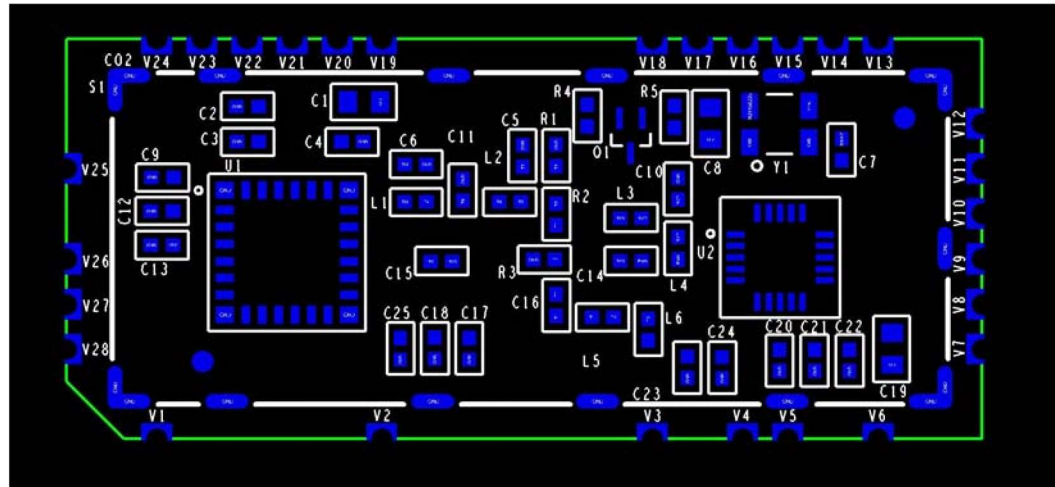
Cet appareil ainsi que son antenne doivent être montés de manière fixe sur des structures intérieures ou extérieures permanentes en conférant une distance d'au moins 20 cm des personnes pendant le fonctionnement normal. Cet appareil n'est pas conçu (et il n'a aucun branchement externe) pour être utilisé en association avec toute autre antenne ou tout émetteur. Aucune autre instruction d'utilisation n'est requise pour assurer la conformité aux règles d'exposition aux RF.

Cet appareil a été soumis à des tests et calibré en usine. Il n'a pas de contrôle d'ajustement et ne peut être ajusté que par un personnel autorisé et qualifié.

Introduction

The information in this document will provide guidance on proper implementation of the Model 101-2017-025 Aclara Radio Module (ARM). The ARM is a limited single modular transmitter that can be used on Aclara's proprietary end point devices to support Aclara's RF network. Proper RF performance, within Aclara's licensed operating frequency band of 450 MHz to 470 MHz, can be achieved by following a few design guidelines. With the module implemented properly, there is no need for repeating FCC transmitter tests, saving both time and cost of final device certifications.

Aclara Radio Module (ARM) Pin Diagram



ARM Pin Signal Descriptions

Radio Pin #	Signal Name	Function	I/O Type	Level
V1	GND			
V2	GND			
V3	GND			
V4	GPIO1	TXRX GPIO 1	Digital I/O	3.6 V
V5	GPIO0	TXRX GPIO 0	Digital I/O	3.6 V
V6	GND			
V7	VCC_TXRX	Transceiver Supply Voltage	Power	3.6 V
V8	TXRX_nIRQ	TXRX Interrupt	Digital Output	3.6 V
V9	SPI1_SCK	TXRX Serial Clock	Digital Input	3.6 V
V10	SPI1_MISO	TXRX Serial Data Out	Digital Output	3.6 V
V11	SPI1_MOSI	TXRX Serial Data In	Digital Input	3.6 V
V12	SPI1_nCS	TXRX Chip Select	Digital Input	3.6 V

Radio Pin #	Signal Name	Function	I/O Type	Level
V13	GND			
V14	GPIO2	TXRX GPIO 2	Digital I/O	3.6 V
V15	GPIO3	TXRX GPIO 3	Digital I/O	3.6 V
V16	TXRX_SDN	TXRX Shutdown Signal	Digital Input	3.6 V
V17	OSC_nEN	TCXO Enable Signal	Digital Input	3.6 V
V18	GND			3.6 V
V19	GND			
V20	VCC_TX	PA Supply Voltage	Power	3.6 V
V21	VCC_TX	PA Supply Voltage	Power	3.6 V
V22	RX0TX1	Transmit/Receive Control	Digital Input	3.6 V
V23	SKY_EN	PA Shutdown Control	Digital Input	3.6 V
V24	GND			
V25	VPC	Transmit Power Output Adjust	Analog Input	3.6V
V26	GND			
V27	ANT	Antenna	Analog Bi-Dir	+30 dBm
V28	GND			

Design Guidelines

Power Supply

The host board power supply shall provide a regulated 3.6 VDC output voltage with less than 20 mVAC of ripple. The power supply shall be capable of supplying up to 1.0 A and regulating the 3.6 V output voltage to $\pm 5\%$ tolerance. The transceiver voltage rail, VCC_TXRX, is all that is required to communicate with the RF transceiver and operate the RF circuitry in receive mode. The additional power supply rail, VCC_TX, is required for RF transmissions. VCC_TX supplies the voltage to the RF power amplifier where most of the current is required. An external power FET is typically used to switch the VCC_TX power rail on and off when required.

SPI Interface

A host microcontroller running at 3.6 VDC shall provide the necessary 3.6 V level SPI signaling required by the ARM. The clock frequency of the SPI interface can operate up to a maximum of 10 MHz. The SPI clock is provided by the host microcontroller operating as the master SPI device. The ARM operates as the SPI slave device.

The host device controls all power level settings and valid operating frequencies of the Si4467 transceiver. The firmware controlling the transceiver only supports Aclara's Standard, Extended, and Maximum power level settings. The firmware can only program the Si4467 to use valid operating frequencies within Aclara's licensed 450MHz to 470MHz band of operation.

Antenna

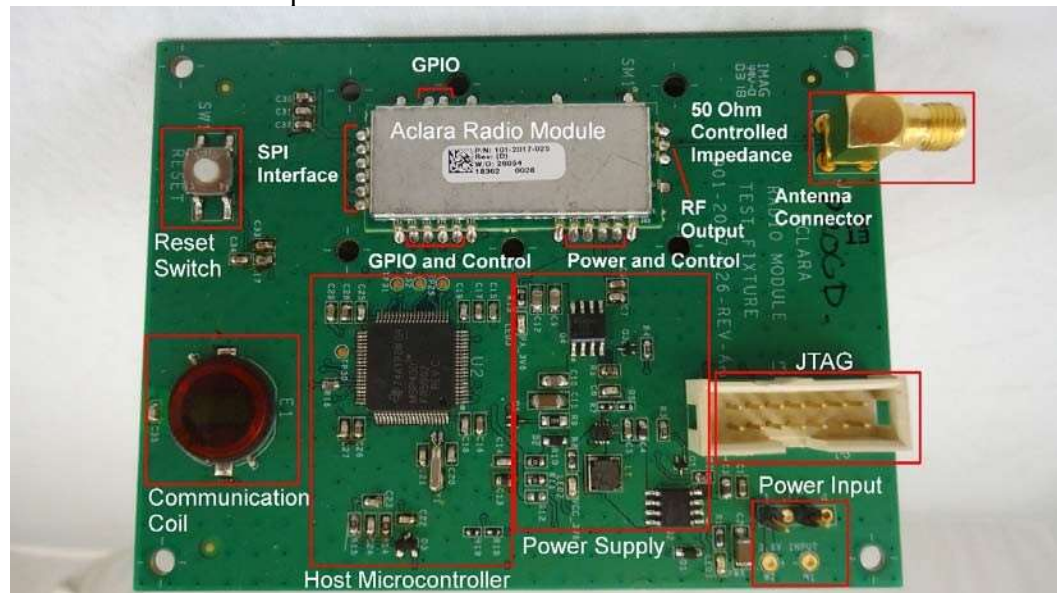
The ARM antenna output shall connect to a host board strip-line that provides a 50 ohm controlled impedance path to an antenna. The strip-line can connect to a RF connector in order to support an external (off-board) antenna or it can connect to an etched (on-board) antenna with a matching network to provide the proper 50 ohm termination for the strip-line. The ARM's maximum RF output level is 30 dBm (1 W) of RF power.

Host Board Stack-Up

The Host PCB stack-up shall be at least a 2-layer stack-up with an overall thickness of 0.062" $\pm$ 0.005" and use a minimum copper weight of 1/4 oz. There shall be a ground flood underneath the ARM module to provide further isolation from any digital interference. High temperature board materials such as Isola 410 or FR-408 with Tg ratings of 170 °C minimum shall be used to maintain coplanarity. The ARM uses castellated vias for connection pins and can be reflowed along with other SMD devices.

ARM Test Board for Certification

The following image shows the Aclara Radio module mounted on a test board used for certification qualification.



The ARM Circuitry of the Test Board

There is a microcontroller that interfaces with the ARM using a Serial Peripheral Interface (SPI). The SPI interface is where all data communications occur between the Host microcontroller and the RF transceiver of the ARM. Both commands and data are passed over the SPI interface. Digital signal levels for the SPI interface are 3.6 V. The SPI interface uses buffered CMOS inputs and outputs. There is a 64-byte TX/RX FIFO buffer internal to the Si4467. The SPI interface only allows data transfer to the transceiver and has no effect on the modulation or data rate of the RF transmitted signal.

A non-contact communication coil is used to control the test board and put the radio into any desired operating mode. Aclara provides a communication puck that when placed next to the communication coil, forms a loosely coupled transformer. On-Off-Keying is then used at a baud rate of 1200 to pass bi-directional data between a controlling device (PC or handheld device) driving the puck (via USB port) and the test board. This is only one method of communicating with the ARM's host microcontroller. Other methods such as direct connect serial ports or opto-isolated serial interfaces can also be used to control the host microcontroller in an end point device. Communications with the host microcontroller is only required during production testing and device installation. The interface for external host microcontroller communications will not affect the signaling of the SPI interface for the ARM.

The power supply provides a regulated 3.6 VDC output to power the ARM module. Nominal test board input voltage is 3.6 V, but it can be varied between 3.0 V and 4.2 V. The on-board power supply is a buck-boost topology and will keep

the ARM voltage at a regulated 3.6 VDC. The test board was designed to operate over a single cell lithium battery voltage range in order to perform testing in RF chambers without the requirement of an AC to DC power supply and the associated conducted noise that can accompany them.

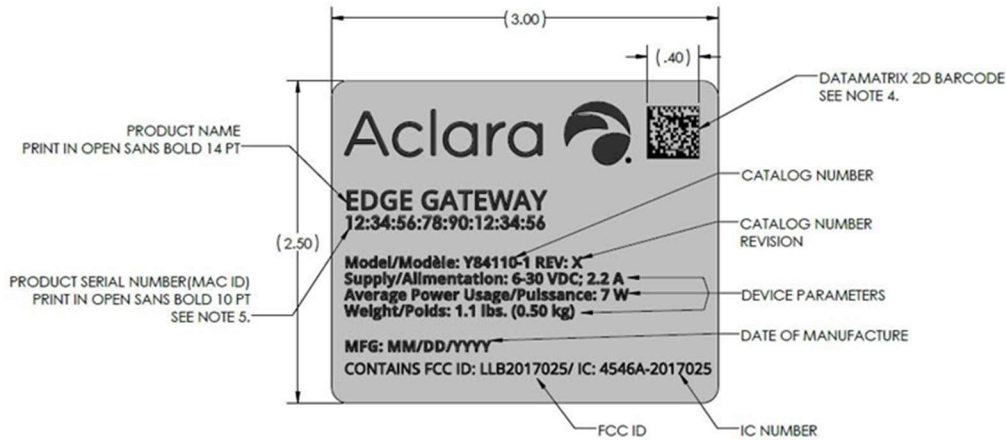
The JTAG port is for programming the host microcontroller. This is done once during the production phase of the device. Any future revisions of device firmware will be programmed over the JTAG port. The reset switch resets the microcontroller if there is a need to do so.

The RF Output of the ARM connects to a 50-ohm controlled impedance strip-line trace that connects to the SMA type RF connector. The RF connector is used to make conducted RF measurements during certification testing.

This information should be enough to assure a proper installation of the ARM into any new Aclara end point device that requires 450 MHz to 470 MHz licensed narrow band RF transmission.

Labeling

Labeling	Étiquetage
The ARM will have a label containing the FCC ID number and the ISED ID number positioned on the top of the module shield. A label with the HVIN number will also be on the shield.	Le module ARM portera une étiquette contenant le numéro d'identification de la FCC et le numéro d'identification de l'ISED dans le haut du boîtier du module. Une étiquette portant le numéro HVIN figurera également sur le boîtier.
Any Aclara product which uses the module as the TX/RX portion of the circuit will have a label on the outside of the product which states that the product:	Tout produit Aclara qui utilise le module comme portion TX/RX du circuit portera en surface une étiquette déclarant que le produit :
CONTAINS: FCC ID: LLB2017025	CONTIENT : ID FCC : LLB2017025
IC: 4546A-2017025	IC : 4546A-2017025
The external label material will be the equivalent of 3M #7871, 2 mil, UV stable gloss polyester, with high strength solvent acrylic adhesive.	Le matériau de l'étiquette extérieure sera équivalent à 3M n° 7871, 2 mil, polyester lustré résistant aux UV avec adhésif acrylique puissant à base de solvant.
A sample label that contains the above information is shown below.	Un exemple d'étiquette contenant les informations qui précèdent est inclus ci-dessous.



PRODUCT NAME PRINT IN OPEN SANS BOLD 14 PT	NOM DU PRODUIT IMPRIMÉ EN OPEN SANS GRAS 14 PT
PRODUCT SERIAL NUMBER (MAC ID) PRINT IN OPEN SANS BOLD 10 PT SEE NOTE 5.	NUMÉRO DE SÉRIE DU PRODUIT (ID MAC) IMPRIMÉ EN OPEN SANS GRAS 10 PT VOIR LA NOTE 5.
DATA MATRIX 2D BARCODE SEE NOTE 4.	MATRICE DE DONNÉES SUR CODE À BARRES 2D VOIR LA NOTE 4.
CATALOG NUMBER	NUMÉRO DU CATALOGUE
CATALOG NUMBER REVISION	NUMÉRO DE RÉVISION DU CATALOGUE
DEVICE PARAMETERS	PARAMÈTRES DE L'APPAREIL
DATE OF MANUFACTURE	DATE DE FABRICATION
IC NUMBER	NUMÉRO IC
FCC ID	ID FCC

Host Product Power Output

Any Aclara host product using the Aclara 101-2017-025 radio module will have the following parameters:

Aclara Radio Module Rated Output Power		
	Conducted Power	Radiated Power with Max.Gain Antenna*
Standard Range	24.31 dBm	29.31 dBm EIRP
Extended Range	29.16 dBm	34.16 dBm EIRP
Maximum Range	30.31 dBm	35.31 dBm EIRP
Standard Range	237 mW	853 mW EIRP
Extended Range	824 mW	2606 mW EIRP
Maximum Range	1073 mW	3396 mW EIRP

*Maximum Antenna Gain = 5 dBi

RF Exposure

RF Exposure	Exposition aux RF
Host products using the ARM could perform many different functions requiring different operational parameters. The host product will meet the FCC and ISSED RF exposure limitations for uncontrolled areas at a distance >20 cm. This can be obtained with the adjustment of power output, transmission duty cycle, or both. For products that are to be installed within a controlled area, the exposure limits may be relaxed to the levels required for controlled areas with the addition of any warnings that might be required for this situation.	Les produits hôtes qui utilisent le module ARM pourraient effectuer différentes fonctions qui requièrent des paramètres d'exploitation variés. Le produit hôte respectera les limites d'exposition aux RF de la FCC et de l'ISED pour les zones non contrôlées à une distance >20 cm. Cela peut être obtenu en ajustant la puissance de sortie, le cycle d'utilisation de la transmission, ou les deux. Pour les produits pour installation dans une zone contrôlée, les limites d'exposition peuvent être allégées aux niveaux requis pour les zones contrôlées avec l'ajout des avertissements requis par la situation.
Using the power levels given above with the max gain antenna, the following conditions will meet the RF exposure limitation for uncontrolled areas at a distance of 20 cm.	En utilisant les puissances données ci-dessus pour le gain d'antenne maximal, les conditions suivantes respectent les limites d'exposition aux RF pour les zones non contrôlées à une distance de 20 cm.

Range	EIRP	Duty Cycle
Standard	853 mW EIRP	100%
Extended	2606 mW EIRP	32%
Maximum	3396 mW EIRP	25%
Portée	PIRE	Cycle de service
Standard	853 mW PIRE	100 %
Étendue	2606 mW PIRE	32 %
Maximum	3396 mW PIRE	25 %