



# FREESTAR PRO SERIES TRANSCEIVER MODULES

## ZFSM-201-1

## ZFSM-201-2

Integrated Transceiver Modules for ZigBee / IEEE 802.15.4  
Evaluation Kit available: ZFSM-201-KIT-1

### DESCRIPTION

CEL's FreeStar Pro module provides a high performance and cost effective RF transceiver solution for 2.4 GHz IEEE 802.15.4, ZigBee, and Zigbee PRO wireless networks.

The FreeStar Pro module is based on the Freescale™ MC13224V (ZFSM-201-1) or MC13226V (ZFSM-201-2) transceiver platforms. It combines Freescale's transceiver IC with an onboard 100mW Power Amplifier. Ideal for remote sensing, AMR/AMI, home and building automation, industrial control, and security applications, FreeStar Pro combines extensive processing capability with high output power and low power consumption.

The processing power of the MC1322xV enables the FreeStar Pro to provide a level of integration unprecedented in a ZigBee module. The 32-bit ARM7TDMI processor and expansive on-chip memory enable designers to eliminate the peripheral host processors often required by 8- and 16-bit transceiver solutions. This high level of integration reduces component count, lower power consumption and overall system costs.

### FEATURES

- Powerful 32-bit ARM7TDMI based microprocessor
- Extensive on-board memory resources
- Up to 100 mW output power
- Miniature footprint: 1" x 1.4" (25.4 mm x 36.5 mm)
- Integrated PCB trace antenna
- Optional MMCX connector for external antenna
- 15 RF channels
- Over 4000 feet of range
- AES 128-bit encryption
- Low power consumption
- FCC, CE and IC certified
- RoHS compliant

### FREESTAR PRO ZFSM-201-x



- Transmit Power: 100 mW
- Receive Sensitivity: -94 dBm
- Freescale MC1322xV platform
- 128 kB Serial Flash Memory
- 96 kB SRAM
- 80 kB ROM
- 32-bit ARM7TDMI-based MCU
- 46 GPIO Pins
- 12-bit ADC

### APPLICATIONS

#### Automated Meter Reading

- In meter applications
- Thermostats
- In-home display units

#### Home & Building Automation

- Security
- HVAC control
- Lighting control
- Thermostats

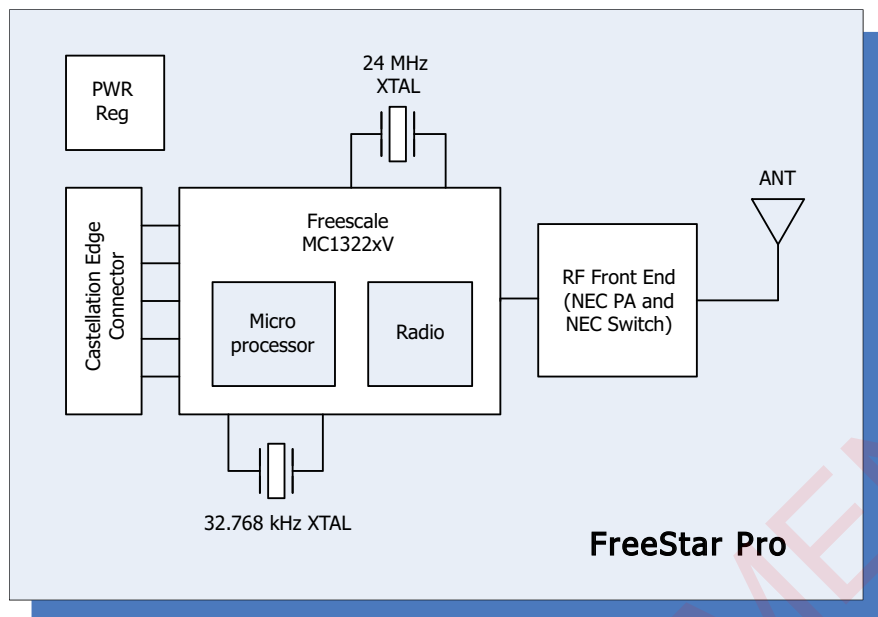
#### Industrial Controls

- Food processing controls
- Traffic Management
- Sensor Networks
- Asset Management
- Barcode reader
- Patient Monitoring
- Glucose monitor

### ORDERING INFORMATION

Part Number	Order Number	Description	Mins/Mults
FreeStar Pro ZFSM-201	ZFSM-201-1	FreestarPro MC13224 100mW transceiver module PCB Trace Antenna	1,960 pcs / 140 pcs
	ZFSM-201-1C	FreestarPro MC13224 100mW transceiver module with MMCX connector	
	ZFSM-201-2	FreestarPro MC13226 100mW transceiver module PCB Trace Antenna	
	ZFSM-201-2C	FreestarPro MC13226 100mW transceiver module with MMCX connector	
	ZFSM-201-KIT-1	FreeStar Pro Module Kit	1

**FREESTAR PRO MODULE BLOCK DIAGRAM**



**EVALUATION KIT**

The FreeStar Pro Kits assists users in both evaluation and development. As a stand alone radio system, the kit allows users to place the modules into the target environment and evaluate performance. The FreeStar Pro kit also serves as an invaluable aid in application development. Through the many headers on the interface board, the user has access to all pins on the ZFSM-201-1 enabling easy connection to the target system for application development.

The FreeStar Pro module contains the Freescale™ MC1322xV transceiver IC, an NEC high gain Power Amplifier, XTALs, Power Regulator, and an integrated PCB antenna.

The interface board features a serial communication interface, a power management module, peripherals such as potentiometer LEDs, and GPIO headers. The Evaluation Kit also contains four AA batteries and two USB cables.

For more detailed information regarding FreeStar Pro Evaluation Kit, refer to the FreeStar Pro Evaluation Kit User Guide document. (Available at CEL's website <http://www.cel.com>)



**Kit Contents:**

- Three Evaluation Boards with ZFSM-201-1 Modules
- Two USB A/B Cables
- Ten Jumpers (Spares)
- Four AA Batteries
- Software & Technical Information CD

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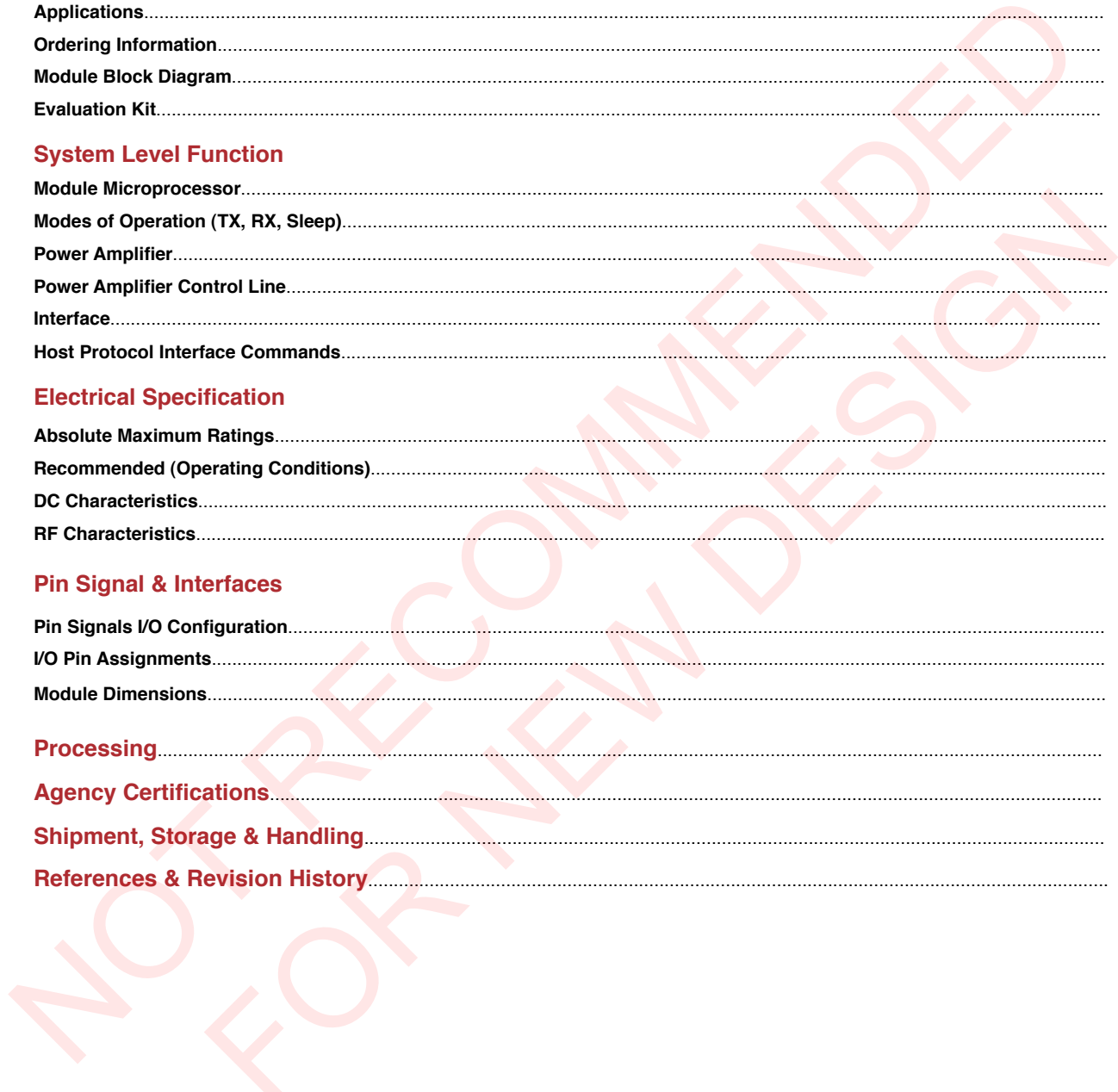
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## MICROPROCESSOR

The primary component of the FreeStar Pro module is Freescale's third generation ZigBee platform. It incorporates a complete, low power, 2.4 GHz radio frequency transceiver, 32-bit ARM7TDMI-based microprocessor, hardware acceleration for both IEEE 802.15.4 MAC and AES security plus a full suite of processor peripherals.

The MC1322xV architecture offers superior processing power for ZigBee applications. The core operates up to 26 MHz. An 80 kByte ROM is utilized for the low level IEEE 802.15.4 MAC and PHYsical layer commands. This off loads the Flash memory, leaving more space for the end user application. The MC1322xV supports 128 kBytes of Flash memory. The program code is mirrored in 96 kBytes of RAM for faster execution by the processor core. A full set of peripherals and Direct Memory Access (DMA) capability for transceiver packet data are also included.

In addition, the MC1322xV provides extensive power savings options, including low current sleep modes allowing for maximum operating life when battery-powered.

The MC1322x family is available as two part numbers. These device types differ only in their ROM contents, all other device hardware, performance, and specifications are identical:

- **MC13224V** - this is the original version and is the generic part type.
  - The MC13224V is intended for most IEEE 802.15.4 applications including MAC-based, ZigBee-2007 Profile 1, and ZigBee RF4CE targets.
  - It has a more complete set of peripheral drivers in ROM.
- **MC13226V** - this is a more recent version and is provided specifically for ZigBee-2007 Profile 2 (Pro) applications. Only the onboard ROM image has been changed to optimize ROM usage for the ZigBee Pro profile and maximize the amount of available RAM for application use.
  - The IEEE MAC/PHY functionality has been streamlined to include only that functionality required by the ZigBee specification. The MAC functionality is 802.15.4 compatible.
  - For a typical application, up to 20 kbytes more of RAM is available versus the M13224V
  - Some drivers present in the MC13224 ROM have been removed and these include the ADC, LCD font, and SSI drivers. These drivers are still available as library functions, but now compile into the RAM space.
  - The Low Level Component (LLC) functionality has also been streamlined for the ZigBee Specification.

## ANTENNA

FreeStar Pro modules include an integrated PCB trace antenna. An optional MMCX connector can be specified, enabling connection to a 50-ohm external antenna of the user's choice. See Ordering Information on page 1.

The PCB antenna employs an F-Antenna topology that is compact and supports an omni-directional radiation pattern. To maximize antenna efficiency, an adequate ground plane must be provided on the host PCB. Correctly positioned, the ground plane on the host board under the module will contribute significantly to antenna performance.

The position of the module on the host board and overall design of the product enclosure contribute to antenna performance. Poor design affects radiation patterns and can result in reflection, diffraction, and/or scattering of the transmitted signal.

Here are some design guidelines to help ensure antenna performance:

- Never place the ground plane or route copper traces directly underneath the antenna portion of the module.
- Never place the antenna close to metallic objects.
- In the overall design, ensure that wiring and other components are not placed near the antenna.
- Do not place the antenna in a metallic or metallized plastic enclosure.
- Keep plastic enclosures 1cm or more from the antenna in any direction.

## MODES OF OPERATION

FreeStar Pro power management is controlled through the Freescale MC1322xV's Clock and Reset Module (CRM). The CRM is a dedicated module to handle clock, reset, and power management functions including control of the power regulators. All these functions have direct impact on attaining the lowest power.

The FreeStar Pro module supports three modes of operation: Active, Doze and Hibernation. The latter two modes are the low-power sleep modes.

### Active Mode

In this mode all functions / features are operating normally.

### Doze Mode

Doze mode provides significant reduction in power consumption while still maintaining a high degree of sleep timing accuracy. In Doze mode, the reference oscillator of the processor continues to operate normally.

### Hibernation Mode

Hibernation mode provides the greatest reduction in power consumption however the sleep timing accuracy is not as precise as in Doze mode.

The CRM manages the recovery from the low-power modes, similar to power-up from reset, providing regulator and clock management.

The module can be awoken from the low-power modes in 3 ways, wake-up can occur:

- On external interrupts through any of the 4 Keyboard Interface inputs
- From internal interrupts
- On the Real Time (wake-up) timer interrupt

For more detail information on modes of operation refer to Freescale's MC1322xV datasheet available at Freescale's website ([www.freescale.com](http://www.freescale.com))

## POWER AMPLIFIER

The FreeStar Pro module incorporates a high performance Power Amplifier from Renesas Electronics.

### Power Amplifier Control Line

FreeStar Pro modules include a separate 1.8V regulator supplying a bias that enables consistent module output performance over the wide operating range. To prevent excessive sleep current draw, this regulator should be disabled when the module is placed into sleep mode. The voltage regulator is controlled by GPIO42 (ANT1), setting GPIO42 high enables the regulator while setting GPIO42 low disables the regulator. See the table below for the Turn on Time requirements for the voltage regulator.

#### SPECIFICATIONS – GPIO42

Parameter	Min	Typ	Max	Unit
Regulator enable voltage		0.95		V
Regulator disable voltage		0.40		V
Turn on Time for VOUT=1.8V (Default)		105	200	$\mu$ sec

For the TX\_ON and RX\_ON pins, the function table is as follows:

Parameter	TX Mode	RX Mode
TX_ON	High	Low
RX_ON	Low	High

#### Other Notes:

- The GPIO43 (ANT2) pin is not used and is left unconnected.
- Due to the long turn on time (105 $\mu$ s) of the regulator, the regulator is enabled or ON all the time with the exception of sleep mode.
- The RF switch uses both the TX\_ON and RX\_ON outputs as control inputs.
- The PA uses the TX\_ON line as the control input.

## INTERFACE

The FreeStar Pro module has all major pins routed to the castellation connectors, this includes, but is not limited, to the pins for JTAG, serial communication, A/D, etc.

## HOST PROTOCOL INTERFACE COMMANDS

CEL provides the Host Serial and RF Protocols document which details the protocols and commands between the Host processor (i.e. an external microprocessor, a PC, etc.) and the FreeStar Pro module. An example of the commands, but not limited to, included in the host protocol interface are as follows:

- Query Version (MAC version)
- Set RF Channel
- Set RF Power
- Transmit Packet Error Test

For more detail refer to Host Serial and RF Protocols document listed on our website at <http://www.cel.com> (FreeStar Pro Host & RF Protocol)

**ABSOLUTE MAXIMUM RATINGS**

Description	Min	Max	Unit
Power Supply Voltage	-0.3	3.6	VDC
Voltage on Any Digital Pin	-0.3	VCC + 0.2	VDC
RF Input Power		10	dBm
Storage Temperature Range	-45	125	°C
Reflow Soldering Temperature		260	°C

**Note:** Exceeding the maximum ratings may cause permanent damage to the module.

**RECOMMENDED OPERATING CONDITIONS**

Description	Min	Typ	Max	Unit
Power Supply Voltage (Vcc)	2.1		3.6	VDC
Ambient Temperature Range	-40	25	85	°C
Crystal Reference Oscillator		24		MHz

**DC CHARACTERISTICS** (@ 25°C, VCC = 3.3V unless otherwise noted)

Description	Typ	Max	Unit
Transmit Mode Current (at +20 dBm Output Power)	193		mA
Receive Mode Current	30		mA
Hibernate or Doze Mode Current	5		µA

**RF CHARACTERISTICS** (@ 25°C, VCC = 3.3V unless otherwise noted)

Parameter	Min	Typ	Max	Unit
<b>General Characteristics</b>				
RF Frequency Range	2400		2483.5	MHz
RF Data Rate		250		kbps
<b>Transmitter</b>				
Nominal Output Power		20		dBm
Programmable Output Power Range		18		dB
Error Vector Magnitude		8	35	%
<b>Receiver</b>				
Receiver Sensitivity (1% PER)	-92	-94		dBm
Saturation (Maximum Input Level) (1% PER)	0			dBm
802.15.4 Adjacent Channel Rejection ( $\pm 5$ MHz)	35	40		dB
802.15.4 Alternate Channel Rejection ( $\pm 10$ MHz)		50		dB

**PIN SIGNALS I/O PORT CONFIGURATION**

The FreeStar Pro module has 60 edge I/O interfaces for connection to the user’s host board. Figure 1 shows the layout of the 60 edge castellations.



**FREESTAR PRO I/O PIN ASSIGNMENTS**

Pin #	Name	Type	Description	IC Pin #
1	GND	GND	GND	85
2	GND	GND	GND	84
3	GND	GND	GND	75
4	ADC2_VREFL	Analog Input or Digital I/O	GPIO39 Alternate function: Low reference voltage for ADC2	61
5	ADC1_VREFL	Analog Input or Digital I/O	GPIO41 Alternate function: Low reference voltage for ADC1	62
6	ADC1_VREFH	Analog Input or Digital I/O	GPIO40 Alternate function: High reference voltage for ADC1	63
7	ADC2_VREFH	Analog Input or Digital I/O	GPIO38 Alternate function: Low reference voltage for ADC2	64
8	ADC0	Analog Input or Digital I/O	GPIO30 Alternate function: ADC analog input Channel 0	1
9	ADC1	Analog Input or Digital I/O	GPIO31 Alternate function: ADC analog input Channel 1	2
10	ADC2	Analog Input or Digital I/O	GPIO32 Alternate function: ADC analog input Channel 2	3
11	ADC3	Analog Input or Digital I/O	GPIO33 Alternate function: ADC analog input Channel 3	4
12	VCC	Power Input	High side supply voltage to buck regulator switching MOSFET & IO buffers	45
13	ADC4	Analog Input or Digital I/O	GPIO34 Alternate function: ADC analog input Channel 4	5
14	ADC5	Analog Input or Digital I/O	GPIO35 Alternate function: ADC analog input Channel 5	6
15	ADC6	Analog Input or Digital I/O	GPIO36 Alternate function: ADC analog input Channel 6	7
16	ADC7_RTCK	Analog Input or Digital I/O	GPIO37 Alternate function: ADC analog input Channel 7 / Return Clock	8
17	TDO	Digital I/O	GPIO49 Alternate function: JTAG Test Data Output	9
18	TDI	Digital I/O	GPIO48 Alternate function: JTAG Test Data Input	10
19	TCK	Digital I/O	GPIO47 Alternate function: JTAG Test Clock Input	11
20	TMS	Digital I/O	GPIO46 Alternate function: JTAG Test Mode Select Input	12
21	UART2_RTS	Digital I/O	GPIO21 Alternate function: UART2 Request to Send input	13
22	GND	GND	GND	76
23	UART2_CTS	Digital I/O	GPIO20 Alternate function: UART2 Clear to Send output	14
24	UART2_RX	Digital I/O	GPIO19 Alternate function: UART2 RX data input	15
25	UART2_TX	Digital I/O	GPIO18 Alternate function: GPIO18UART2 TX data output	16
26	UART1_RTS	Digital I/O	GPIO17 Alternate function: UART1 Request to Send input	17
27	UART1_CTS	Digital I/O	GPIO16 Alternate function: UART1 Clear to Send output	18
28	I2C_SDA	Digital I/O	GPIO13 Alternate function: I2C Bus data	21



**FREESTAR PRO I/O PIN ASSIGNMENTS** (Continued)

Pin #	Name	Type	Description	IC Pin #
29	I2C_SCL	Digital I/O	GPIO12 Alternate function: I2C Bus clock	22
30	TMR3	Digital I/O	GPIO11 Alternate function: Timer 3 IO signal	23
31	VCC	Power Input	High side supply voltage to buck regulator switching MOSFET & IO buffers	45
32	TMR2	Digital I/O	GPIO10 Alternate function: Timer 2 IO signal	24
33	TMR1	Digital I/O	GPIO9 Alternate function: Timer 1 IO signal	25
34	TMR0	Digital I/O	GPIO8 Alternate function: Timer 0 IO signal	26
35	SPI_SCK	Digital I/O	GPIO7 Alternate function: SPI Port clock	27
36	UART1_TX	Digital I/O	GPIO14 Alternate function: UART1 TX data output	20
37	UART1_RX	Digital I/O	GPIO15 Alternate function: UART1 RX data input	19
38	GND	GND	GND	77
39	SPI_MOSI	Digital I/O	GPIO6 Alternate function: SPI Port MOSI	28
40	SPI_MISO	Digital I/O	GPIO5 Alternate function: SPI Port MISO	29
41	SPI_SS	Digital I/O	GPIO4 Alternate function: SPI Port SS	30
42	SSI_BITCK	Digital I/O	GPIO3 Alternate function: SSI Bit Clock	31
43	SSI_FSYN	Digital I/O	GPIO2 Alternate function: SSI Frame Sync	32
44	SSI_RX	Digital I/O	GPIO1 Alternate function: SSI RX data input	33
45	SSI_TX	Digital I/O	SSI TX data output / GPIO0	34
46	KBI_7	Digital I/O	GPIO29 Alternate function: Keyboard Interface Bit 7	35
47	COIL_BK	Power Switch Output	Buck Converter coil drive output	43
48	KBI_6	Digital I/O	GPIO28 Alternate function: Keyboard Interface Bit 6	36
49	RESETB	Digital Input	System reset input	51
50	LREG_BK_FB	Power Input	Voltage input to onboard regulators, buck regulator feedback voltage	44
51	GND	GND	GND	78
52	KBI_5	Digital I/O	GPIO27 Alternate function: Keyboard Interface Bit 5	37
53	KBI_4	Digital I/O	GPIO26 Alternate function: Keyboard Interface Bit 4	38
54	KBI_3	Digital I/O	GPIO25 Alternate function: Keyboard Interface Bit 3	39
55	KBI_2	Digital I/O	GPIO24 Alternate function: Keyboard Interface Bit 2	40
56	KBI_1	Digital I/O	GPIO23 Alternate function: Keyboard Interface Bit 1	41
57	KBI_0_HST_WK	Digital I/O	GPIO22 Alternate function: Keyboard Interface Bit 0 / Host Walk-up output	42
58	GND	GND	GND	79
59	GND	GND	GND	86
60	GND	GND	GND	87

**MODULE DIMENSIONS** Dimensions in inches. Tolerances = +/-0.005" unless otherwise noted.

**FreeStar PRO ZFSM-201-x**

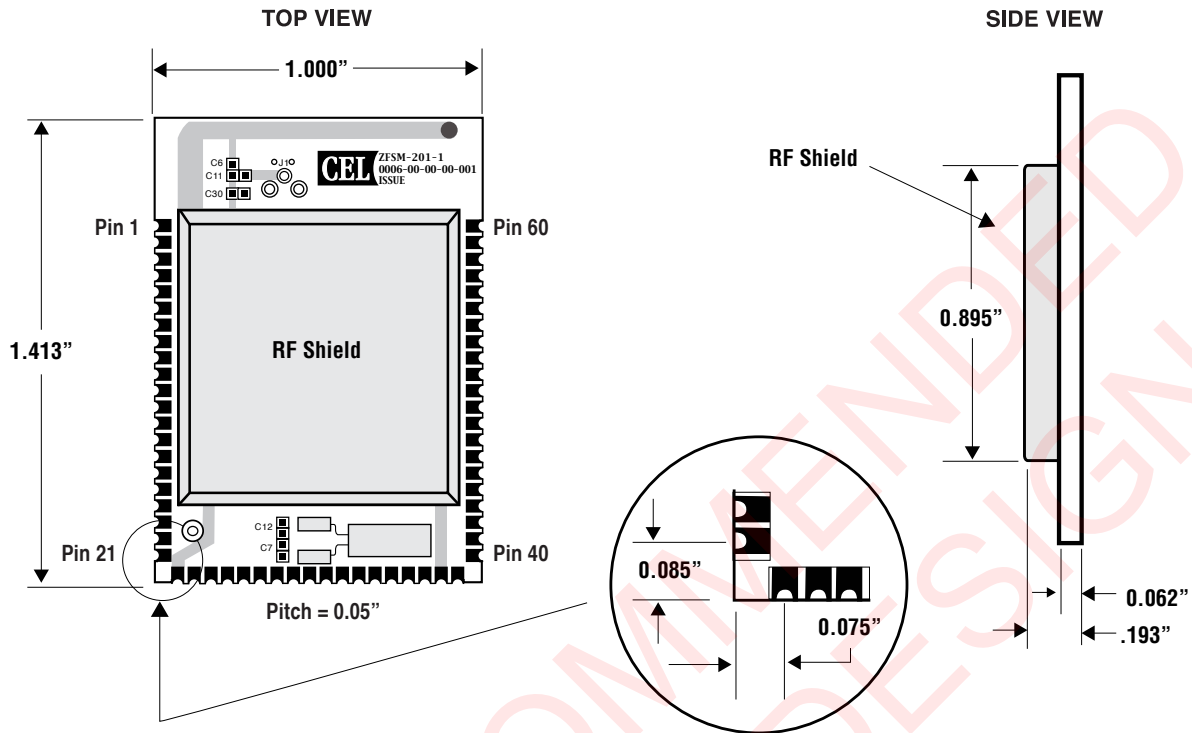


Figure 1a

**FreeStar PRO ZFSM-201-xC**

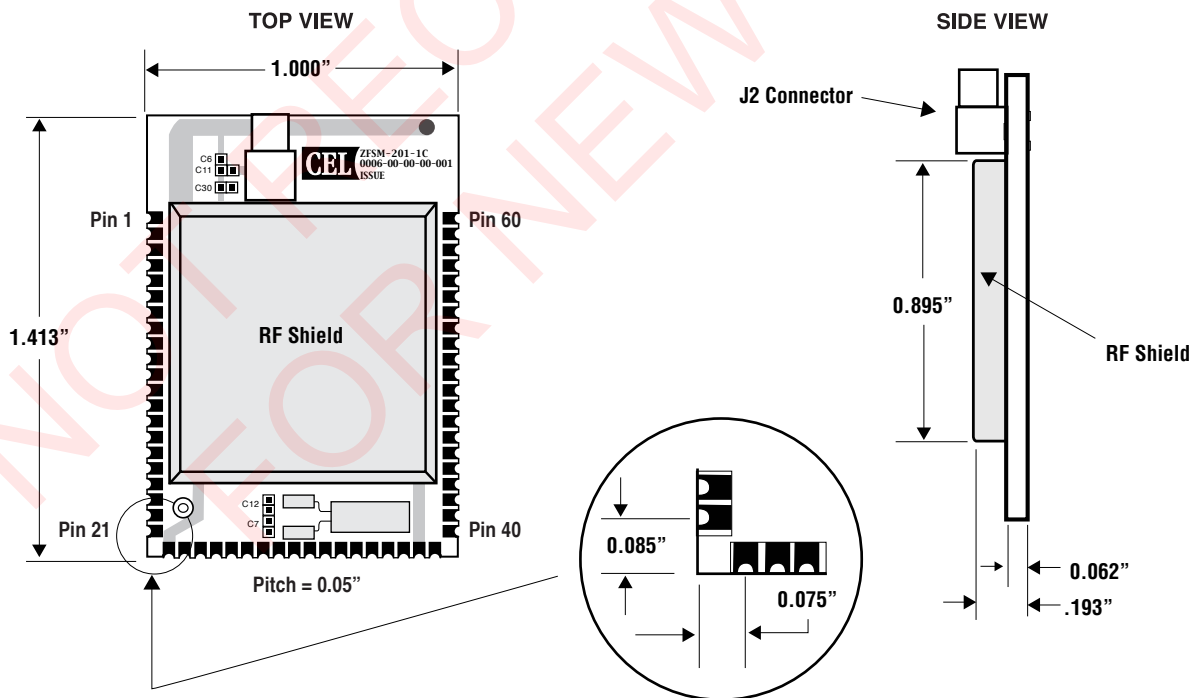


Figure 1b

For layout recommendation for optimum antenna performance, refer to Antenna section in this document.

**MODULE LAND FOOTPRINT**

**NOTE:** Dimensions in inches [mm]. Tolerances = +/-0.005" unless otherwise noted.

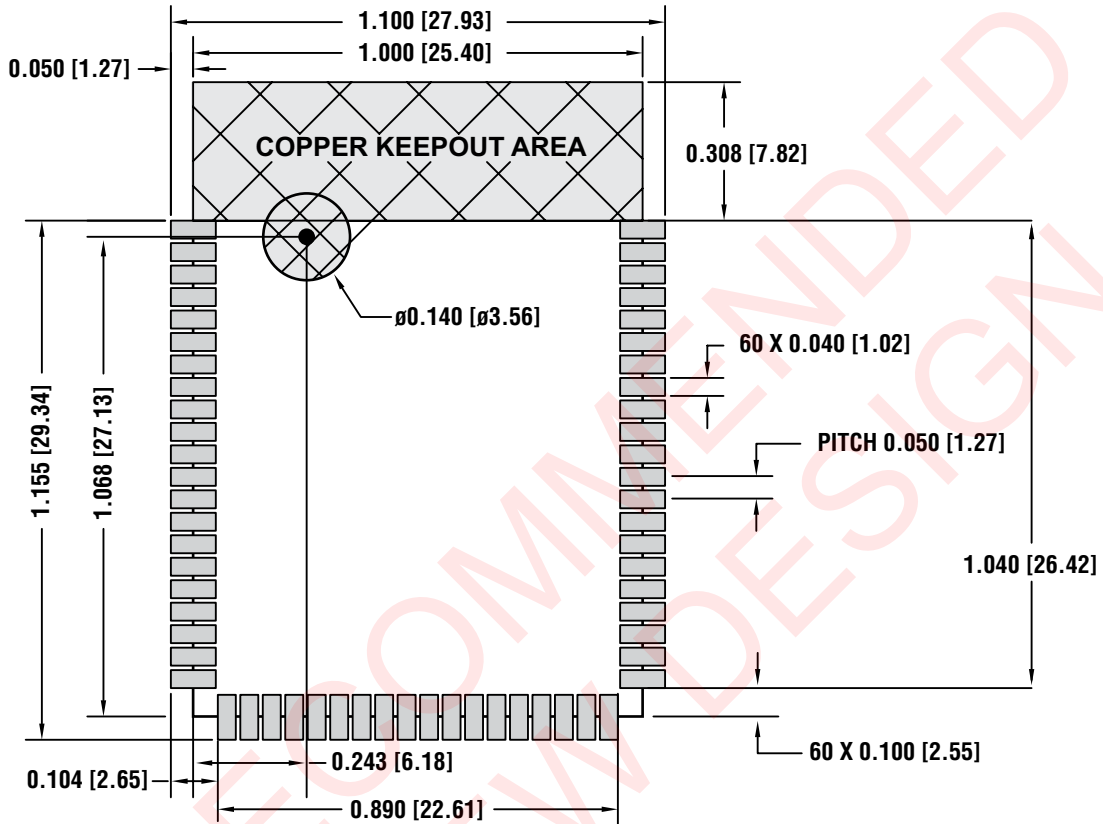


Figure 2

## PROCESSING

### Recommended Reflow Profile

#### Parameters Values

Ramp up rate (from Tsoakmax to Tpeak) 3°/sec max

Minimum Soak Temperature 150°C

Maximum Soak Temperature 200°C

Soak Time 60-120 sec

TLiquidus 217°C

Time above TL 60-150 sec

Tpeak 250°C

Time within 5° of Tpeak 20-30 sec

Time from 25° to Tpeak 8 min max

Ramp down rate 6°C/sec max

Achieve the brightest possible solder fillets with a good shape and low contact angle.

### Pb-Free Soldering Paste

Use of “No Clean” soldering paste is strongly recommended, as it does not require cleaning after the soldering process.

**Note:** The quality of solder joints on the castellations (‘half vias’) where they contact the host board should meet the appropriate IPC Specification. See **IPC-A-610** Acceptability of Electronic Assemblies, section 8.2.4 “Castellated Terminations.”

### Cleaning

In general, cleaning the populated modules is strongly discouraged. Residuals under the module cannot be easily removed with any cleaning process.

- Cleaning with water can lead to capillary effects where water is absorbed into the gap between the host board and the module. The combination of soldering flux residuals and encapsulated water could lead to short circuits between neighboring pads. Water could also damage any stickers or labels.
- Cleaning with alcohol or a similar organic solvent will likely flood soldering flux residuals into the two housings, which is not accessible for post-washing inspection. The solvent could also damage any stickers or labels.
- Ultrasonic cleaning could damage the module permanently.

The best approach is to consider using a “no clean” soldering paste and eliminate the post-soldering cleaning step.

### Optical Inspection

After soldering the Module to the host board, consider optical inspection to check the following:

- Proper alignment and centering of the module over the pads.
- Proper solder joints on all pads.
- Excessive solder or contacts to neighboring pads, or vias.

### Repeating Reflow Soldering

Only a single reflow soldering process is encouraged for host boards.

### Wave Soldering

If a wave soldering process is required on the host boards due to the presence of leaded components, only a single wave soldering process is encouraged.

### Hand Soldering

Hand soldering is possible. Use a soldering iron temperature setting equivalent to 350°C, follow IPC recommendations/reference document IPC-7711.

**PROCESSING** (Continued)

**Rework**

The FreeStar Pro Module can be unsoldered from the host board. Use of a hot air rework tool and hot plate for pre-heating from underneath is recommended. Avoid overheating.

**Warning**

Never attempt a rework on the module itself, e.g. replacing individual components. Such actions will terminate warranty coverage.

**Additional Grounding**

Attempts to improve module or system grounding by soldering braids, wires, or cables onto the module RF shield cover is done at the customers own risk. The numerous ground pins at the module perimeter should be sufficient for optimum immunity to external RF interference.

**AGENCY CERTIFICATIONS**

**FCC Part 15.247 Module Certified (Mobile)**

The Freestar Pro modules comply with Part 15 of the Federal Communications Commission rules and regulations and with Industry Canada license exempt RSS standards.

To meet the Certification requirements, the user must meet these regulations:

- The text on the FCC ID label provided with the module must be placed on the outside of the final product.
- The modules may only use the antennas that have been tested and approved with these modules:
  - The on-board PCB trace antenna
  - Nearson S181AH-2450S antenna.

Per Section 2.109, the Freestar Pro module has been certified by the FCC for use with other products without additional certification. Any modifications to this product may violate the rules of the Federal Communications Commission and make operation of the product unlawful.

Per Sections 15.107 and 15.109, the user’s end product must be tested for unintentional radiators compliance.

**RF Output Power Setting**

In order to comply with FCC and Industry Canada emissions requirements, the Freestar Pro module has the following power shaping requirements implemented:

- Order Numbers ZFSM-201-1, ZFSM-201-2 which use the integrated PCB antenna, are limited to power step 4 for channels 11 & 12 with channel 26 being disabled.
- Order Numbers ZFSM-201-1C, ZFSM-201-2C which has the MMCX connector, has firmware that limits the power to CEL Test Tool setting 4 on channels 11-25, with channel 26 being disabled.

In addition to restricting power, the firmware also limits the maximum data payload to 106 bytes for any transmitted packet. The firmware also limits the transmission rate such that a maximum duty cycle of 32 percent is allowed.

**RF Output Power**

	Certification	RF Channel	CEL Test Tool	Typical Max Output Power
ZFSM-201-1 ZFSM-201-2	FCC/IC	11,12	4	10 dBm
		13-25	6	20dBm
	ETSI	11-25	4	10dBm
ZFSM-201-1C ZFSM-201-2C	FCC/IC	11-25	4	10dBm
	ETSI	11-25	4	10dBm

## AGENCY CERTIFICATIONS (Continued)

### FCC Compliance Statement (Part 15.19) Section 7.15 of RSS-GEN

This device complies with Part 15 of the FCC Rules and with Industry Canada license exempt RSS Standards. 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.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

1. l'appareil ne doit pas produire de brouillage, et
2. l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

### Warning (Part 15.21)

Changes or modifications not expressly approved by CEL could void the user's authority to operate the equipment.

### 20 cm Separation Distance

To comply with FCC/IC RF exposure limits for general population / uncontrolled exposure, the antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

### OEM Responsibility to the FCC Rules and Regulations

The FreeStar Pro Module has been certified per FCC Part 15 rules and to Industry Canada license-exempt RSS Standards for integration into products without further testing or certification. To fulfill the FCC and IC certification requirements, the OEM using the FreeStar Pro Module must ensure that the information provided on the FreeStar Pro Label is placed on the outside of the final product. The FreeStar Pro Module is labeled with its own FCC ID Number and IC ID Number. If the FCC ID is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains Transmitter Module FCC ID: W7Z-FSTARPRO" or "Contains FCC ID: W7Z-FSTARPRO"

The OEM using the FreeStar Pro Module must only use the approved antennas, (PCB Trace Antenna or Nearson Whip Antenna Model S181AH-2450S) that has been certified with this module. The OEM using the FreeStar Pro Module must test their final product configuration to comply with Unintentional Radiator Limits before declaring FCC compliance per Part 15 of the FCC rules.

### IC Certification – Industry Canada Statement

The term "IC" before the certification / registration number only signifies that the Industry Canada technical specifications were met.

### Certification IC - Déclaration d'Industrie Canada

Le terme "IC" devant le numéro de certification / d'enregistrement signifie seulement que les spécifications techniques Industrie Canada ont été respectées.

### Section 14 of RSS-210

The installer of this radio equipment must ensure that the antenna is located or pointed such that it does not emit RF field in excess of Health Canada limits for the general population. Consult Safety Code 6, obtainable from Health Canada's website: <http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/99ehd-dhm237/index-eng.php>

### L'article 14 du CNR-210

Le programme d'installation de cet équipement radio doit s'assurer que l'antenne est située ou orientée de telle sorte qu'il ne pas émettre de champ RF au-delà des limites de Santé Canada pour la population générale. Consulter le Code de sécurité 6, disponible sur le site Web de Santé Canada: <http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/99ehd-dhm237/index-eng.php>

**AGENCY CERTIFICATIONS** *(Continued)*

**CE Certification – Europe**

The FreeStar Pro RF module has been tested and certified for use in the European Union.

**OEM Responsibility to the European Union Compliance Rules**

If the FreeStar Pro module is to be incorporated into a product, the OEM must verify compliance of the final product to the European Harmonized EMC and Low-Voltage / Safety Standards. A Declaration of Conformity must be issued for each of these standards and kept on file as described in Annex II of the R&TTE Directive.

The manufacturer must maintain the user's guide and adhere to the settings described in the manual for maintaining European Union Compliance. If any of the specifications are exceeded in the final product, the OEM is required to make a submission to the notified body for compliance testing.

**OEM Labeling Requirements**

The `CE' mark must be placed on the OEM product in a visible location.

The CE mark shall consist of the initials “CE” with the following form:

- If the CE marking is reduced or enlarged, the proportions given in the above graduated drawing must be adhered to.
- The CE mark must be a minimum of 5mm in height
- The CE marking must be affixed visibly, legibly, and indelibly Since the 2400 - 2483.5 MHz band is not harmonized by a few countries throughout Europe, the Restriction sign must be placed to the right of the `CE' marking as shown in the picture



**SHIPMENT, HANDLING, AND STORAGE**

**Shipment**

The FreeStar Pro Modules are delivered in trays of 140 pieces.

**Handling**

The FreeStar Pro Modules are designed and packaged to be processed in an automated assembly line.

**Warning**

The FreeStar Pro Modules contain highly sensitive electronic circuitry. Handling without proper ESD protection may destroy or damage the module permanently.

**Warning**

According to JEDEC ISP, the FreeStar Pro Modules are moisture sensitive devices. Appropriate handling instructions and precautions are summarized in Section 2.1. Read carefully to prevent permanent damage due to moisture intake.

**Moisture Sensitivity Level (MSL)**

MSL 3, per J-STD-033

**Storage**

Storage/shelf life in sealed bags is 12 months at <40°C and <90% relative humidity.



## REFERENCES & REVISION HISTORY

### References

Reference Documents
FreeStar Pro Module Evaluation Kit User Guide
FreeScale MC1322xV Datasheet
Freescale Semiconductor MC1322x Reference Manual MC1322xRM
Freescale Semiconductor BeeKit™ User Guide BKWCTKUG
Freescale Semiconductor Software Driver Reference Manual 22XDVRMM
Freescale Semiconductor MC1322x Simple Media Access Controller (SMAC) Reference Manual 22xSMACRM
Freescale Semiconductor Simple Media Access Controller (SMAC) User's Guide SMACRM
IAR J-Link and IAR J-Trace user Guide J-Link_J-TraceARM-1
ARM® IAR Embedded Workbench® IDE User Guide UARM-13

### Revision History

Previous Versions	Changes to Current Version	Page
0006-00-07-00-000 (Preliminary) October 28, 2008	Initial advance datasheet.	N/A
0006-00-07-00-000 (Preliminary) May 20, 2009	Updated to current revisions to the Freescale Silicon IC	N/A
0006-00-07-00-000 (Preliminary) June 11, 2009	Updated FCC and IC Agency Statements	14-15
0006-00-07-00-000 August 17, 2009	Updated RF Output Power Setting	6
0006-00-07-00-000 (Issue A) December 10, 2010	Added the MC13226 (ZFMS-201-2) Transceiver platform Option	All
0006-00-07-00-000 (Issue B) June 25, 2012	Updated FCC and Agency Statements (added French translation), updated RF Output Power information, reformatted and repaginated document	13-15
0006-00-07-00-000 (Issue B) June 28, 2012	Updated Module Land Footprint diagram	11
0006-00-07-00-000 (Issue B) November 2, 2012	Updated Minimum Order Quantity	1

### Disclaimer

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