DATA SHEET

SNAP Engine 700 Series

Model Number: SM700

Part Number: SM700PC1

Doc# 430136-01C

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Errata

Be sure you are using the latest SNAP firmware, which is the official release for the MC1322X chip and the Model SM700 module. All of the following errata can be found in the SNAP Reference Manual; be sure to read the sections on the MC1322x chip and the SM700 module.

1. Wakeup pins

   Four pins, GPIO_26 through GPIO_29, can be configured to wake the module from sleep. Note that these pins automatically become inputs when entering sleep. Four other pins, GPIO_22 through GPIO_25 automatically become outputs when entering sleep (this behavior is not under software control).

2. Network IDs

   The MC13224 hardware does not function properly with all network IDs. An MC13224 node set to a network ID that fits the pattern 0xn2nn or 0xnAnn will not be able to receive radio transmissions, though it can still send them. This is an issue with the underlying Freescale radio.

   For example:

   Network ID 0xFADE does not work. Network ID 0xFBDE does work.

3. Built-in functions – setPinPullup()

   The setPinPullup() function does not apply a pull-up to GPIO_30 through GPIO_41. No internal pull-ups are available on these pins.

4. Built-in functions – sleep()

   There are four sleep() modes on the MC13224 module. Even-numbered sleep modes do not require that an external 32 kHz crystal be connected and are less accurate with their timing. (The internal clock can be regulated on a node-by-node basis, if necessary, using NV Parameter 65.) Odd-numbered sleep modes provide very accurate timing but require the presence of the external crystal.

Sleep Mode	Details
0, 1	• Fast recovery • GPIO states are maintained during sleep† • Highest current usage
2, 3	• Fast recovery • GPIO states are NOT maintained (though they are reset on waking)

   † Pins GPIO_22, GPIO_23, GPIO_24, and GPIO_25 will always shift to being outputs while the node is sleeping in all sleep modes. Pins GPIO_26, GPIO_27, GPIO_28, and GPIO_29 will always shift to being inputs while the node is sleeping in all sleep modes.

SNAP Engines SM700 Series Modules Overview

Synapse raises the bar for integrated performance with its SNAP Engine SM700 Series based on the Freescale™ MC13224V transceiver platform. This wireless network module uses an ARM7 32-bit processor with large on-chip memory and integrated 12-bit ADCs.

Like all SNAP Engines, the Model SM700 comes with SNAP® already loaded and ready to perform right out of the box. SNAP is Synapse's award-winning, mesh network operating system that provides wireless connectivity for Internet-to-machine and machine-to-machine communications.

With 96K RAM of memory, large applications can bring intelligence to the very edge of the network for local operations. These applications can be uploaded over-the-air… even mesh hopping across the network to reach their destination. And because of the large memory in the SM700, the core SNAP operating system can also be upgraded over-the-air leaving your network in place and intact.

Very little board space is needed for this SNAP Engine (25mm x 36mm). Even the antenna is integrated to further reduce system size and cost. The SM700 can achieve a range of over 1.5 miles and deliver an output of up to +20dBm. For applications requiring battery power, the Model SM700 can perform at current consumption levels as low as 12 µA.

This Data Sheet details the SM700PC1 module, which includes:

- Powerful 32-bit TDMI ARM7 microprocessor
- Large on-board memory resources
- 2.4 GHz RF Frequency (2400 - 2483.5 MHz)
- Up to 100mW output power
- 16 RF Channels
- 2.0 to 3.6 Volts Vcc
- Small footprint: 1" x 1.4" (25.4mm x 36.5mm)
- Operating temperature: -40°C to +85°C
- Low current consumption:
  - Transmit mode…….193mA
  - Receive mode……27mA
  - Sleep mode……12uA
- Over 1.5 miles range
- AES 128-bit encryption
- FCC, CE and IC certified
- Integrated F-antenna
- Accurate 12-bit ADC for precision sensors
- Small surface-mount IC footprint

Specifications

Table 1.1: SM700PC1 Specifications at 25° C

Performance	Outdoor LOS Range	Up to 1.5 miles at 250Kbps
	Transmit Power Output	20 dBm
	RF Data Rate	250Kbps
	Receiver Sensitivity	-94 dBm (1% PER)
Power Requirements	Supply Voltage	2.0 - 3.6 V
	Transmit Current (Typ@3.3V)	193mA
	Idle/Receive Current (Typ@3.3V)	30mA
	Power-down Current (Typ@3.3V)	12µA
General	Frequency	ISM 2.4GHz
	Spreading Method	DSSS
	Modulation	O-QPSK
	Dimensions	1" x 1.4" (25.4mm x 36.5mm)
	Operating Temperature	- 40 to 85 deg C.
	Antenna Options	Integrated F-antenna
Networking	Topology	SNAP
	Error Handling	Retries and acknowledgement
	Number of Channels	16
Available I/O	UARTS with HW Flow Control	2
	GPIO	46 total; 12bit ADC; 8 can be analog in with 12b + ADC
Agency Approvals	FCC Part 15.247	FCC ID: U9O-SM700
	Industry Canada (IC)	IC: 7084A-SM700
	CE Certified	Yes

Module Pin Definitions

Table 1.2: SM700PC1 Module Pin Assignments

Pin	SNAPpy IO	Name	Description
1		GND	GND
2		GND	GND
3		GND	GND
4	39	ADC2_VREFL	GPIO39, Alternate function: Low reference voltage for ADC2
5	41	ADC1_VREFL	GPIO41, Alternate function: Low reference voltage for ADC1
6	40	ADC1_VREFH	GPIO40, Alternate function: High reference voltage for ADC1
7	38	ADC2_VREFH	GPIO38, Alternate function: Low reference voltage for ADC2
8	30	ADC0	GPIO30, Alternate function: ADC0
9	31	ADC1	GPIO31, Alternate function: ADC1
10	32	ADC2	GPIO32, Alternate function: ADC2
11	33	ADC3	GPIO33, Alternate function: ADC3
12		VCC	High side supply voltage to buck regulator switching MOSFET & IO buffers
13	34	ADC4	GPIO34, Alternate function: ADC4
14	35	ADC5	GPIO35, Alternate function: ADC5
15	36	ADC6	GPIO36, Alternate function: ADC6
16	37	ADC7_RTCK	GPIO37, Alternate function: ADC7 / Return Clock
17	49	TDO	GPIO49, Alternate function: JTAG Test Data Output
18	48	TDI	GPIO48, Alternate function: JTAG Test Data Input
19	47	TCK	GPIO47, Alternate function: JTAG Test Clock Input
20	46	TMS	GPIO46, Alternate function: JTAG Test Mode Select Input
21	21	UART2_RTS	GPIO21, Alternate function: UART2 Request to Send input
22		GND	GND
23	20	UART2_CTS	GPIO20, Alternate function: UART2 Clear to Send output
24	19	UART2_RX	GPIO19, Alternate function: UART2 RX data input
25	18	UART2_TX	GPIO18, Alternate function: GPIO18UART2 TX data output
26	17	UART1_RTS	GPIO17, Alternate function: UART1 Request to Send input
27	16	UART1_CTS	GPIO16, Alternate function: UART1 Clear to Send output
28	13	I2C_SDA	GPIO13, Alternate function: I^2C Bus data

Pin	SNAPpy IO	Name	Description
29	12	I2C_SCL	GPIO12, Alternate function: I^2C Bus clock
30	11	TMR3	GPIO11, Alternate function: Timer 3 IO signal
31		VCC	High side supply voltage to buck regulator switching MOSFET & IO buffers
32	10	TMR2	GPIO10, Alternate function: Timer 2 IO signal
33	9	TMR1	GPIO9, Alternate function: Timer 1 IO signal
34	8	TMR0	GPIO8, Alternate function: Timer 0 IO signal
35	7	SPI_SCK	GPIO7, Alternate function: SPI Port clock
36	14	UART1_TX	GPIO14, Alternate function: UART1 TX data output
37	15	UART1_RX	GPIO15, Alternate function: UART1 RX data input
38		GND	GND
39	6	SPI_MOSI	GPIO6, Alternate function: SPI Port MOSI
40	5	SPI_MISO	GPIO5, Alternate function: SPI Port MISO
41	4	SPI_SS	GPIO4, Alternate function: SPI Port SS
42	3	SSI_BITCK	GPIO3, Alternate function: SSI Bit Clock
43	2	SSI_FSYN	GPIO2, Alternate function: SSI Frame Sync
44	1	SSI_RX	GPIO1, Alternate function: SSI RX data input
45	0	SSI_TX	SSI TX data output / GPIO0
46	29	KBI_7	GPIO29, Alternate function: Keyboard Interface Bit 7
47		COIL_BK	Buck Converter coil drive output
48	28	KBI_6	GPIO28, Alternate function: Keyboard Interface Bit 6
49		RESETB	System reset input
50		LREG_BK_FB	Voltage input to onboard regulators, buck regulator feedback voltage
51		GND	GND
52	27	KBI_5	GPIO27, Alternate function: Keyboard Interface Bit 5
53	26	KBI_4	GPIO26, Alternate function: Keyboard Interface Bit 4
54	25	KBI_3	GPIO25, Alternate function: Keyboard Interface Bit 3
55	24	KBI_2	GPIO24, Alternate function: Keyboard Interface Bit 2
56	23	KBI_1	GPIO23, Alternate function: Keyboard Interface Bit 1
57	22	KBI_0_HST _ WK	GPIO22, Alternate function: Keyboard Interface Bit 0 / Host Walk-up output

Pin	SNAPpy IO	Name	Description
58		GND	GND
59		GND	GND
60		GND	GND

Electrical Characteristics

Table 1.3: SM700 Series DC Characteristics at 25° C

Symbol	Parameter	Condition	Min	Typ	Max	Units
V_{CC}[1]	Supply Voltage		2.1	3.3	3.6	V
T_{OP}	Operating Temp		-40°		85°	°C
T_{STOR}	Storage Temp					°C
V_{IH}	Input Hi Voltage	All Digital Inputs			V_{CC}+.02	V
V_{IL}	Input Low Voltage	All Digital Inputs	-0.3			V
TX-I_{CC}	Transmit Current (at +20 dBm Output Power)	V_{CC} = 3.3V		193 mA		mA
RX-I_{CC}	Receive Current	V_{CC} = 3.3V		30 mA		mA
SHDN-I_{CC}	Sleep Current	V_{CC} = 3.3V		12µA		µA

Table 1.4: 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
Reflow Soldering Temperature		260	ºC

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

1 Absolute maximum stress rated voltage for VCC is -0.3 to 3.6. It is recommended that bulk capacitance be located as close as possible to the VCC pin on the host board. Ideally, use a single 47µF capacitor at 10V directly at the VCC pin.

Table 1.5: Recommended Operating Conditions

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

Mechanical Drawings

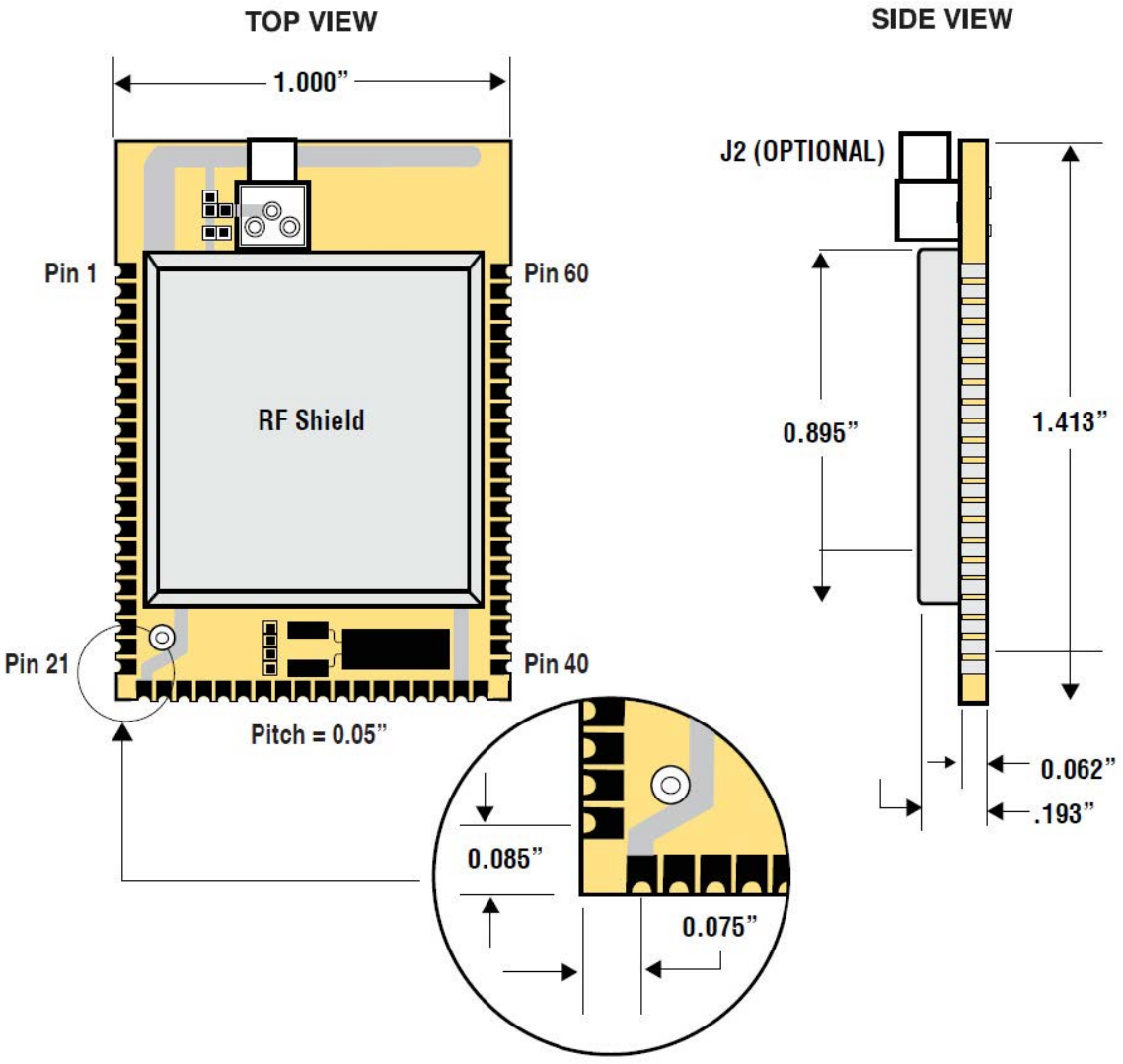

Figure 1.1: Mechanical drawings of the SM700PC1 Module

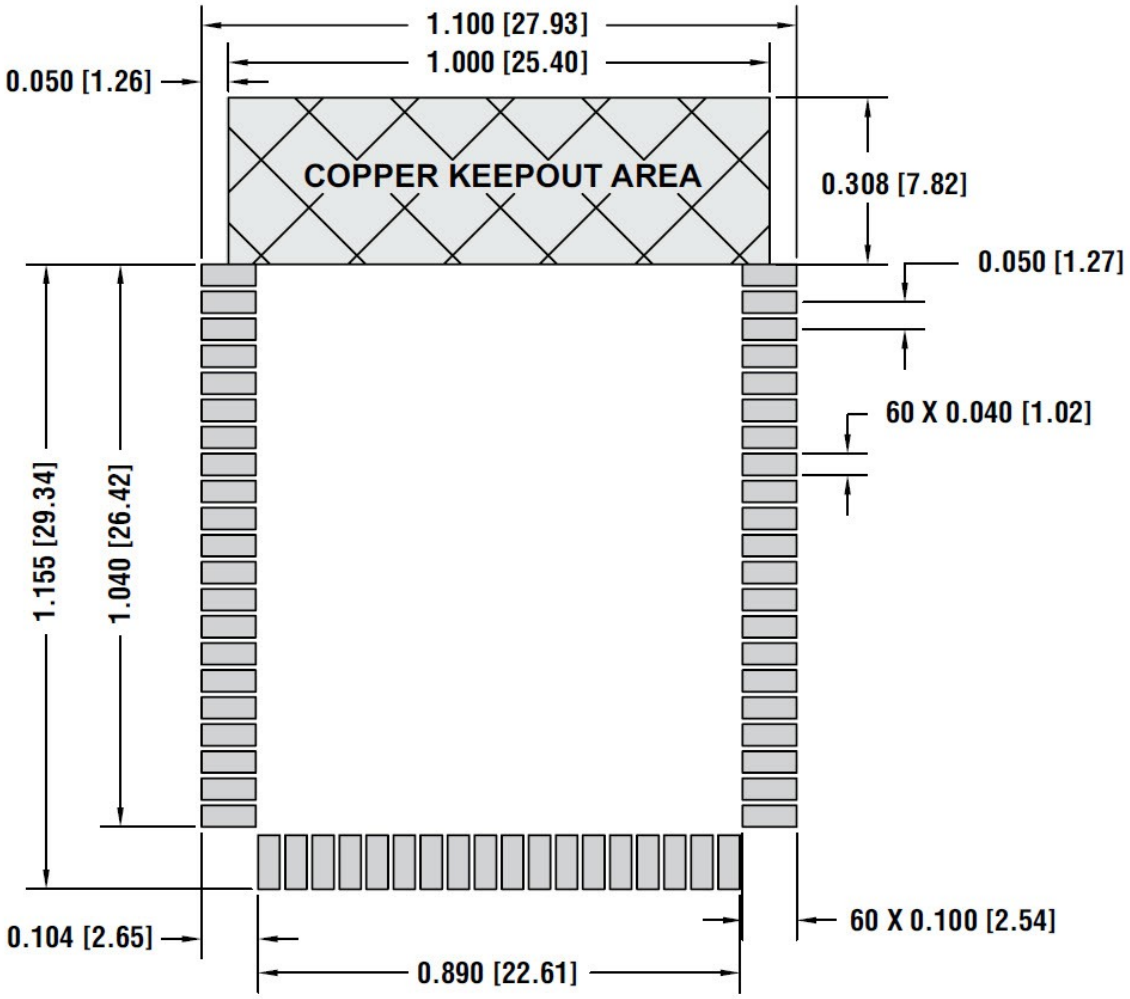

Figure 1.2: Module Land Footprint for the SM700PC1 Module

NOTE: The area under the module's antenna (marked NO COPPER or KEEP OUT AREA) should have no components, no traces, and no copper on any layer of the printed circuit board.

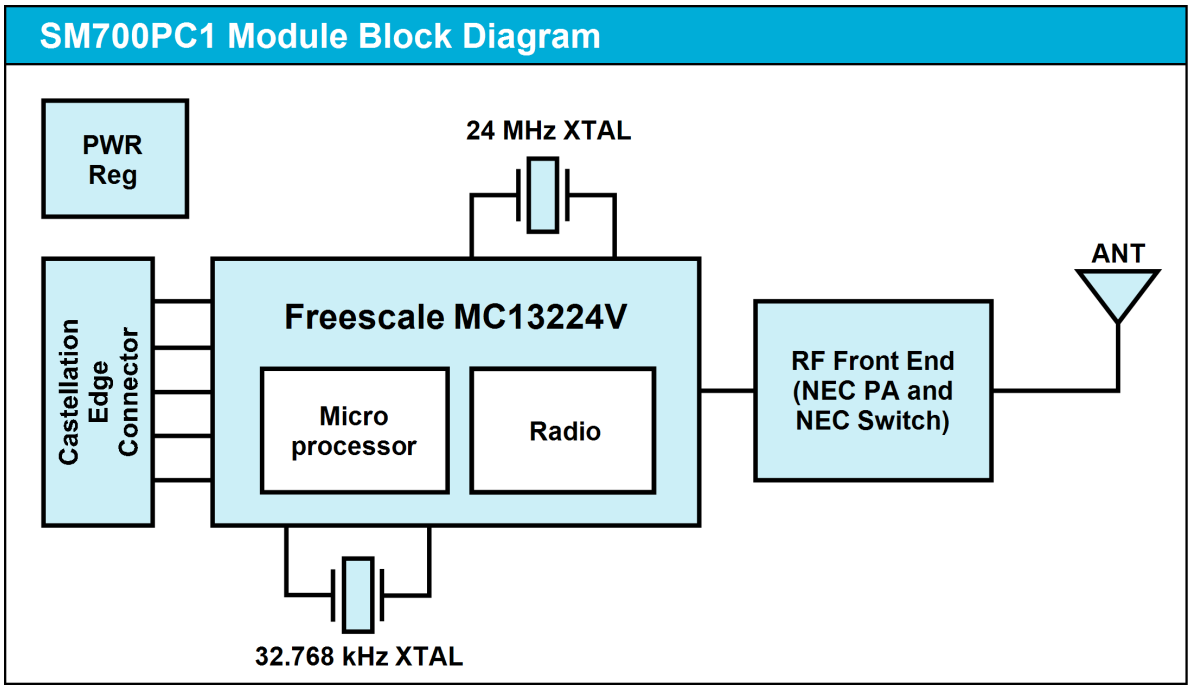

Figure 1.3: Block diagram showing the major subsystems comprising the SM700PC1

Board Mounting Considerations

Processing

Table 1.6: Recommended Reflow Profile

Parameter	Value
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.

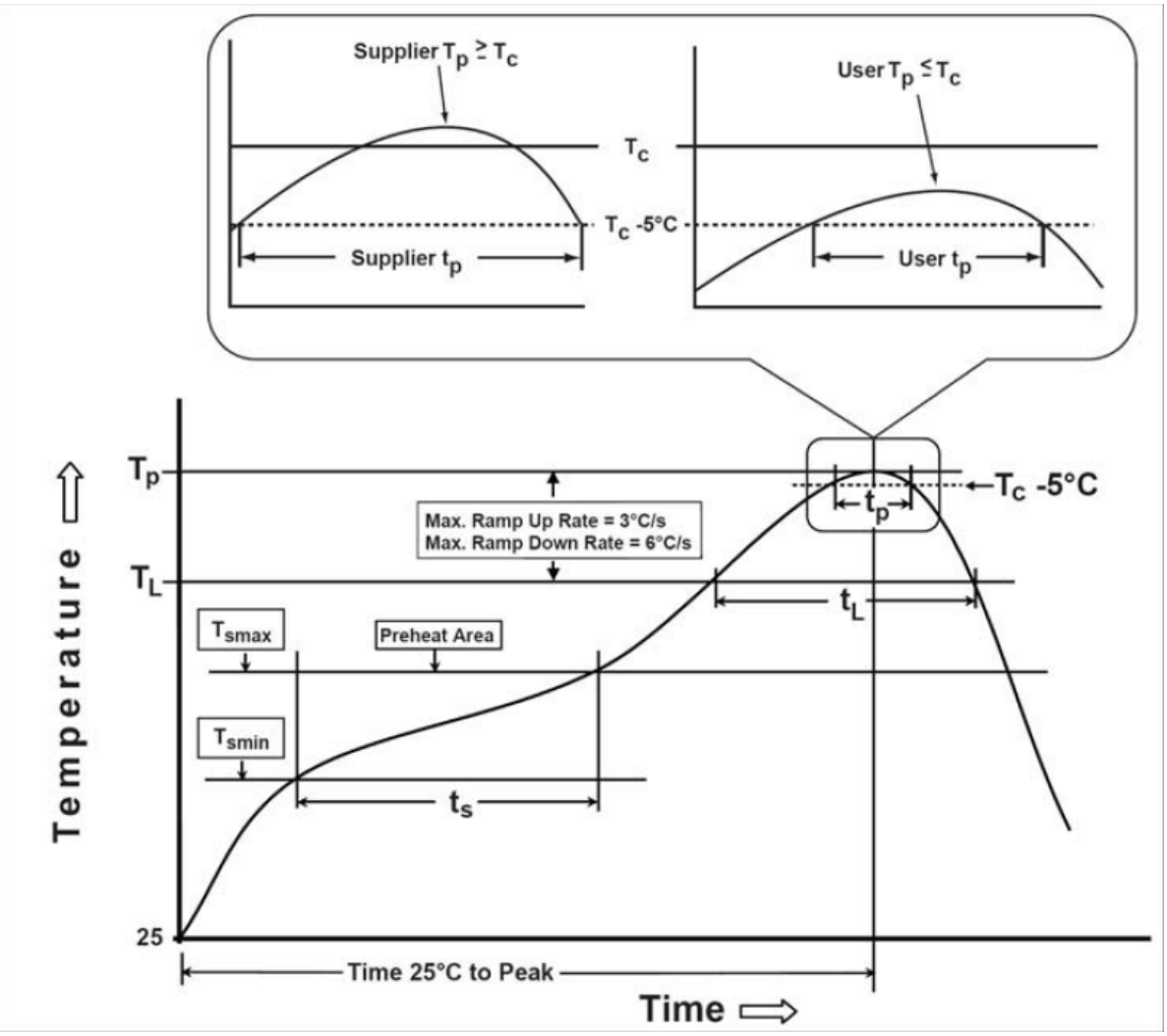

Figure 1.4: SM700 Peak Reflow Profile

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.

Rework

The Model SM700 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

United States (FCC)

The Model SM700 modules comply with Part 15 of the FCC rules and regulations. Compliance with the labeling requirements, FCC notices, and antenna usage guidelines are required. In order to comply with FCC Certification requirements, the Original Equipment Manufacturer (OEM) must fulfill the following requirements.

1. The system integrator must place an exterior label on the outside of the final product housing the SM700 Modules. **Figure 2.1** below shows the contents that must be included on this label.
2. SM700 Modules may only be used with the antenna that has been tested and approved for use with the module.

OEM Labeling Requirements

NOTICE: The OEM must make sure that FCC labeling requirements are met. This includes a clearly visible exterior label on the outside of the final product housing that displays the contents shown in **Figure 2.1** below.

MANUFACTURERSNAME
BRANDNAME or TRADENAME

Contains SM700 FCC ID: U90-SM700

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interferences, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Figure 2.1: FCC Label

FCC Notices

WARNING!: The SM700 modules have been tested by the FCC for use with other products without further certification (as per FCC Section 2.1091). Changes or modifications to this device not expressly approved by Synapse Wireless Inc. could void the user's authority to operate the equipment.

NOTICE: OEM's must certify final end product to comply with unintentional radiators (FCC Sections 15.107 and 15.109) before declaring compliance of their final product to Part 15 of the FCC Rules.

NOTICE: The SM700 modules have been certified for remote and base radio applications. If the module will be used used for portable applications as defined by the FCC, the device must undergo SAR testing.

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.

FCC Approved Antennas

The SM700 modules are FCC-approved for fixed base station and mobile applications.

WARNING!: RF Exposure: This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

NOTICE: The preceding statement must be included as a CAUTION statement in OEM product manuals in order to alert users of FCC RF exposure compliance.

NOTE: Antenna and transmitters may be co-located or operated in conjunction with this device only if the transmitters do not simultaneously transmit. Otherwise, additional regulatory requirements will apply.

Canada (IC)

This device complies with 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 isotropically radiated power (EIRP) is not more than that necessary for successful communication.

OEM Labeling Requirements

The “CE” mark must be placed on the OEM product in a visible location. The CE mark will consist of the Initials “CE” with the following form:

If the CE marking is reduced or enlarged, the proportions given in the following drawing must be adhered too.

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 drawing.

Labeling requirements for Industry Canada are similar to those of the FCC. A clearly visible label on the outside of the final product housing must display the contents shown in **Figure 2.2** below.

MANUFACTURERSNAME
BRANDNAME or TRADENAME
MODEL:

Contains SM700 IC: 7084A-SM700

Figure 2.2: IC Label

NOTE: The OEM can choose to implement a single label combined for both FCC and IC labeling requirements. If a combined single label is chosen, there must be a clearly visible label on the outside of the final product housing displaying the contents shown in **Figure 2.3** below.

MANUFACTURERSNAME
BRANDNAME or TRADENAME

Contains SM700 FCC ID: U90-SM700
Contains SM700 IC: 7084A-SM700

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interferences, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Figure 2.3: Combined FCC and IC Label

NOTE: The OEM can choose to implement a single label combined for FCC, CE and IC labeling requirements. If a combined single label is chosen, there must be a clearly visible label on the outside of the final product housing displaying the contents shown in **Figure 2.4** below.

MANUFACTURERSNAME
BRANDNAME or TRADENAME

Contains SM700 FCC ID: U90-SM700
Contains SM700 IC: 7084A-SM700
CE

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interferences, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Figure 2.4: Combined FCC, CE and IC Label