UMC-6055QV
User Guide

Wistron NeWeb Corp.

CONTENTS

Revision history

Revision	Date	Description
V1.0	April 7 2014	Initial release
V2.0	May 13 2014	Modify recommended operating condition

1. INTRODUCTION

This document describes the hardware interface of the WNC Small Form Factor (SFF) module used to connect the device application and the air interface.

Two versions of Small Form Factor (SFF) module are described in this specification document as follows:

- UMC-6055QV - CDMA2000 1X

1.1 PRODUCT CONCEPT

The SFF module is one of the smallest available CDMA2000 1X modules of the market. The target application is the Machine to Machine (M2M) market including automotive, AMM (Automatic Metering Management), tracking system, Alarm, Healthcare/monitoring, Telematics etc. Despite its small size and cost,

In addition to its size it has the following outstanding characteristics:
- Minimum low power consumption in idle mode: 1.4mA
- High input voltage range: 3.4 V to 4.2 V
- USB High Speed
- Digital Audio PCM
- Full set of AT commands as well as analogue and Digital audio interface.

In addition to the module, a complete development kit can be provided for customers.

1.2 STANDARDS

This product, together with its evaluation board, is in compliance with the directives and standards listed below:

Directives

FCC	
RF : FCC Part 22H (850 Band) FCC Part 24E (for 1900 Band)	FCC Part 22 Subpart H: Cellular Radiotelephone Service; Subpart I: Offshore Radiotelephone Service; FCC Part 24 E: Personal Communications Service; Subpart E: Broadband PCS.
EMI: FCC Part 15B	Subpart B - Radio frequency devices subpart B – Unintentional Radiators
SAR(MPE) : OET65C	

1.3 TERMS AND ABBREVIATION

ADC	Analog to Digital Converter
CODEC	Coder-Decoder
CLIP	Calling Line Identification Presentation
COLP	Connected Line Identification Presentation
CLIR	Calling Line Identification Restriction
COLR	Connected Line Identification Restriction
CTS	Clear To Send
CSD	Circuit Switched Data
CS	Codec Scheme
DSR	Data Set Ready
ENS	Enhanced network selection
EONS	Enhanced operator name string
ESD	Electrostatic Discharge
ETS	European Telecommunication Standard
FAX	Facsimile
IC	Integrated Circuit
IEEE	Institute of Electrical and Electronics Engineers
I/O	Input / Output
ISO	International Standards Organization
ITU	International Telecommunication Union
JTAG	Joint Test Action Group
Kbps	kilobit per second
LCD	Liquid Crystal Display
LED	Light Emitting Diode
Mbps	Megabit per second
PCB	Printed Circuit Board
PCM	Pulse Code Modulation
PCS	Personal Communication System
PWM	Pulse Width Modulation
RAM	Random Access Memory
RF	Radio Frequency
RI	Ring Indication
RMS	Root Mean Square
RTS	Ready To Send
RX	Reception
SMS	Short Message Service
TBC	To Be Confirmed
TBD	To Be Defined
TX	Transmission
UART	Universal Asynchronous Receiver and Transmitter
USB	Universal Serial Bus
USSD	Unstructured Supplementary Service Data

1.4 CONVENTIONS

Throughout this document, DTE (data terminal equipment) indicates the equipment which masters and controls the module device by sending AT commands via its serial interface.
DCE (data communication equipment) indicates the module device.

1.5 PRODUCT FEATURES OVERVIEW

Temperature range	Operation Temperature: -25°C to +85°C Storage: -40°C to +85°C
Weight	6 g (typ.)
ESD	ESD protection >= 2 kV

Physical dimensions	22.1 x 25.1 x 2.65 mm (typical)
Connection	141 pin LGA type
Power supply	3.4V to 4.2V range, 3.8V nominal

Power consumption*	Off mode: 50 µA typical
	Registered idle mode:
	    • CDMA2000: 1.3 mA
	Peak Current
	    • CDMA2000: up to 700 mA

Antenna /RF interface	Both GPS and transmitter/receiver RF are LGA Pad.
Frequency bands	UMC-6055QV module supports CDMA2000 BC0/BC1
Transmit power	Class 3 for CDMA2000 BC0/BC1
PWM	Signal for LED, vibrating device and Buzzer management is provided on the PWM pin
Digital audio link	A digital audio interface PCM bus is provided. Master mode with 16 bits and a frequency of 2048 KHz.
Data/command multiplexing	Software management of data/command multiplexing on the serial link UART.
USB	Supports USB High speed 480Mbps and full speed 12Mbps, with 3 logical Channels. Battery charging is achieved through USB

Module Hardware Configuration
The SFF LGA module will support the QSC6055 chipset with the configuration described below.

For UMC-6055QV module:
Key Features
- Compliant with 3GPP for CDMA 1xRTT
- Max. Data Rate : 153kbps FL; 153kbps RL
- Support OS: Brew Mobile Platform
- ARM9 operating at 192Mhz maximum frequency
- Data interface: USB2.0 Host High Speed
- Form Factor: LGA module

Specification
- Communication Interface: (I2C x1/UART x1/USB2.0 x1/SDIO x1)
- Supported SIM cards (3V and 1.8V SIM cards)
- General purpose I/O pins (x25)
- Audio Interface (PCM/ I2S)
- MCP (DDR 512Mb + 1Gb NAND)
- Support GPS
- RF interface: 2 RF pads for CDMA TX/RX, and GPS.

CDMA2000 Support Bands
- Band BC0

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* The power consumption is highly dependent on the customer's product design and the module environment.

- Band BC1

2. BLOCK DIAGRAM & PIN ASSIGNMENT
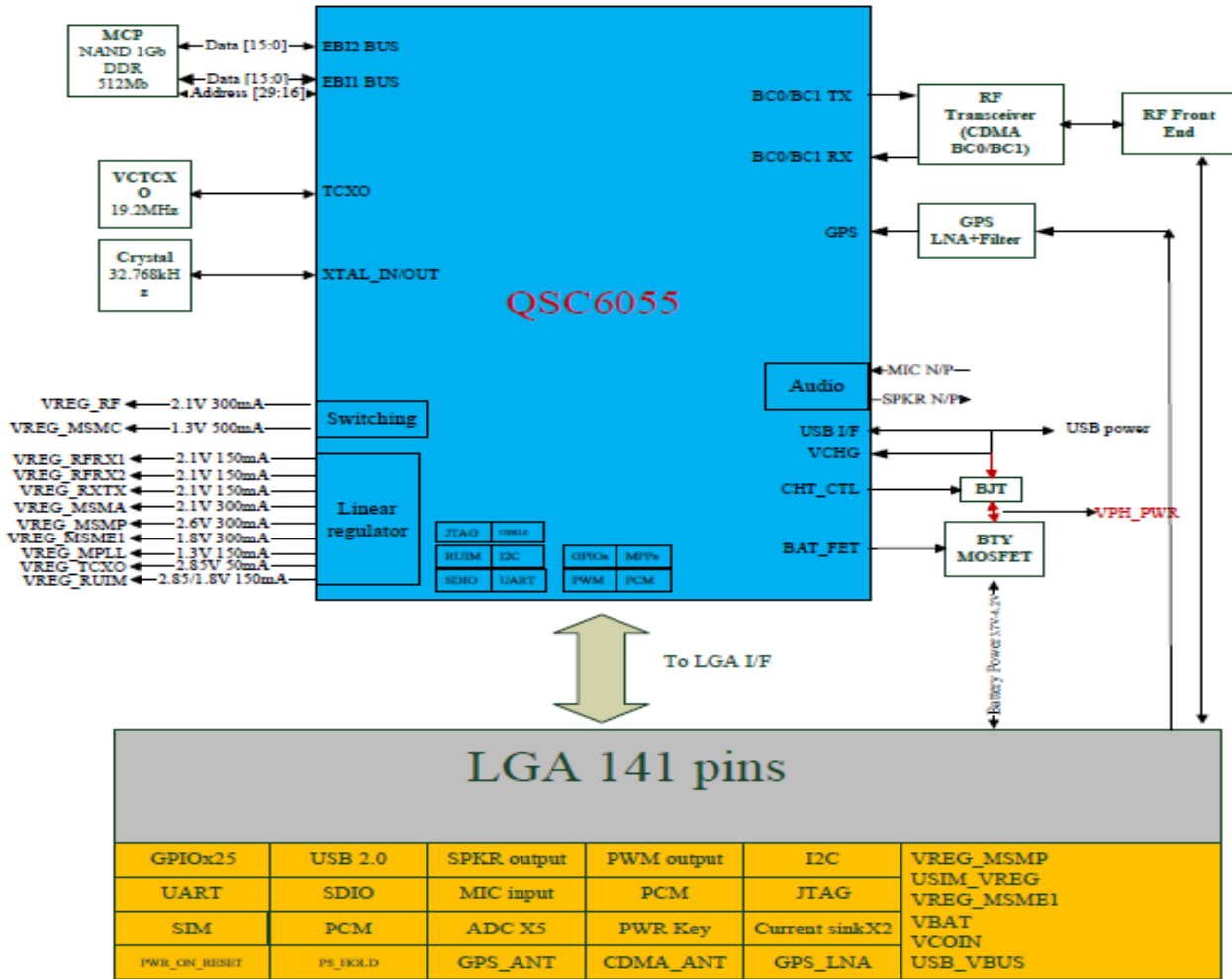
Pin Definition [4]

This section is intended to capture the final LGA pin out for the SFF Module.

The interfaces with a SFF module are all through a 141-pin surface LGA pad, as shown in Figure 2-1.
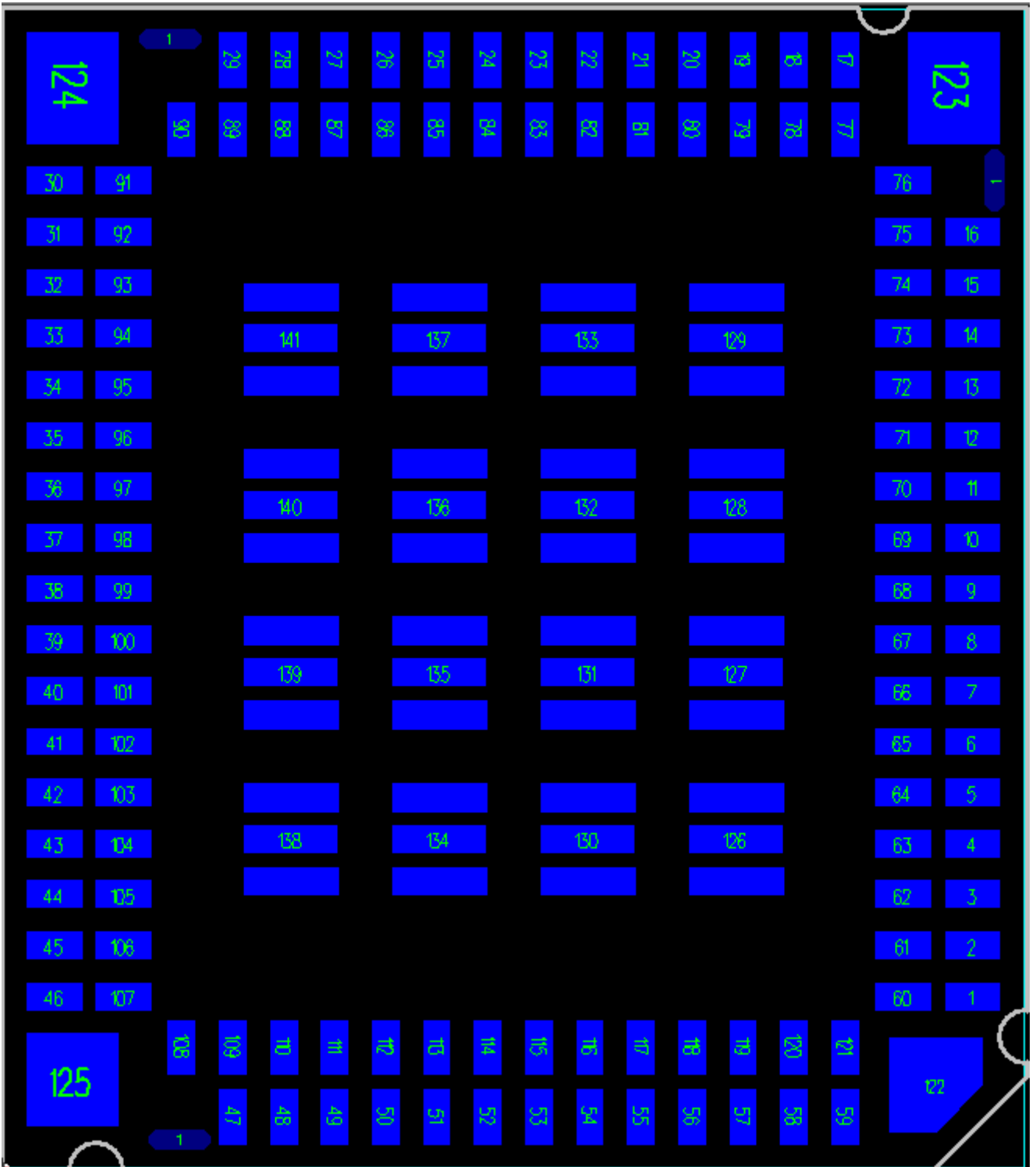
For UMC-6055QV module:

Figure 2-1: UMC-6055QV module

Pin number	Category	pin name	Pad group	Pad type	Description	Drivn capacity
1	RF	CDMA_ANT		AI,AO	CDMA antenna signal	
2	GND	GND		GND	Ground.	
3	GPIO	GPIO9	1.8V	I/O, PD	Configurable I/O.	2-16mA
4	GPIO	GPIO2	1.8V	I/O, PD	Configurable I/O.	2-16mA
5	GPIO	GPIO5	1.8V	I/O, PD	Configurable I/O.	2-16mA
6	GPIO	GPIO8	1.8V	I/O, PD	Configurable I/O.	2-16mA
7	I2C	I2C_SCL	1.8V	I/O	Serial bus clock.	
8	PCM	PCM_BCLK	1.8V	DO	PCM clock for external Bluetooth module.	
9	PCM	PCM_SYNC	1.8V	DO	PCM sync to external Bluetooth module.	
10	PCM	PCM_DIN	1.8V	DI	PCM data from external Bluetooth module.	
11	PCM	PCM_DOUT	1.8V	DO	PCM data to external Bluetooth module.	
12	GPIO	GPS_LNA_EN	1.8V	I/O, PU	Configurable I/O.	2-16mA
13	NC					
14	NC					
15	GND	GND		GND	Ground.	
16	GND	GND		GND	Ground.	
17	RF	GPS_ANT		AI	GPS antenna signal.	
18	GND	GND		GND	Ground.	
19	GPIO	GPIO21	1.8V	I/O, PU	Configurable I/O.	2-16mA
20	GND	GND		GND	Ground.	
21	GPIO	GPIO20	1.8V	I/O, PU	Configurable I/O.	2-16mA
22	GPIO	GPIO16	1.8V	I/O, PU	Configurable I/O.	2-16mA
23	GPIO	GPIO17	1.8V	I/O, PU	Configurable I/O.	2-16mA
24	NC					
25	NC					
26	SDIO1	SDCC1_CMD	2.6V	I/O	SD command.	2-8mA
27	SDIO1	SDCC1_DATA3	2.6V	I/O	SD data bit 3.	2-8mA
28	SDIO1	SDCC1_DA	2.6V	I/O	SD data bit 2.	2-8mA

		TA2				
29	GPIO	GPIO10	1.8V	I/O, PU	Configurable I/O.	2-16mA
30	GND	GND		GND	Ground.	
31	SIM	USIM_CLK	1.8V/2.85V	DO	UIM clock.	
32	NC					
33	power input/output	VBAT_BB	3.7V~4.2V	P	Input power for BB section, could connect this pin with VBAT_RF. voltage or as an analog output that sources trickle-charging current for the battery.	
34	JTAG	JTAG_TMS	2.6V	DI, PU	Test mode select.	
35	JTAG	JTAG_RTCK	2.6V	DO	Return clock.	
36	JTAG	JTAG_TCK	2.6V	DI, PU	Clock input.	
37	SIM	USIM_DAT	1.8V/2.85V	I/O	UIM data.	
38	power input	USB_VBUS		P	This pin is configured as an analog input or an analog output, depending upon the type of peripheral device connected.	
39	power output	USIM_VREG	1.8V/2.85V	P	RUIM circuits and interface.	150mA
40	GND	GND		GND	Ground.	
41	GND	GND		GND	Ground.	
42	NC					
43	NC					
44	power output	VREG_MSME1	1.8V	300mA	EBI circuits and external memory, pads.	
45	GND	GND		GND	Ground.	
46	power input/output	VCOIN		P	Used as an analog input from the 3 V coin cell for SMPL, RTC, and crystal oscillator backup.	
47	GND	GND		GND	Ground.	
48	ADC in	MPP3		AO	Multipurpose pin.	
49	other	PON_REST_N	1.8V	DO	logic low causes the baseband circuits to reset.	
50	GND	GND		GND	Ground.	
51	ADC in	BATT_THERM		AI	Connect to battery package thermal pin.	
52	GND	GND		GND	Ground.	
53	microphone	MIC_P		AI	Microphone #1 input (+).	
54	microphone	MIC_M		AI	Microphone #1 input (-).	
55	GND	GND		GND	Ground.	

56	GPIO	GPIO4	1.8V	I/O, PD	Configurable I/O.	2-16mA
57	GPIO	GPIO6	1.8V	I/O, PU	Configurable I/O.	2-16mA
58	GPIO	GPIO11	1.8V	I/O, PD	Configurable I/O.	2-16mA
59	GPIO	GPIO24	1.8V	I/O, PD	Configurable I/O.	2-16mA
60	GND	GND		GND	Ground.	
61	GPIO	GPIO18	1.8V	I/O, PD	Configurable I/O.	2-16mA
62	GPIO	GPIO15	1.8V	I/O, PD	Configurable I/O.	2-16mA
63	GPIO	GPIO7	1.8V	I/O, PD	Configurable I/O.	2-16mA
64	GPIO	GPIO1	1.8V	I/O, PD	Configurable I/O.	2-16mA
65	I2C	I2C_SDA	1.8V	I/O	I2C serial bus data.	
66	UART	UART_TX	1.8V	DO	UART1 bits: receive serial data input.	
67	UART	UART_RFR	1.8V	DO	UART Ready to receive flow.	
68	UART	UART_RX	1.8V	DI	UART1 bits: receive serial data input.	
69	UART	UART_CTS	1.8V	DI	UART Clear to send flow.	
70	power input	VBAT_RF	3.7V~4.2V	P	Input power for RF section, could connect this pin with VBAT_BB.	
71	power input	VBAT_RF	3.7V~4.2V	P	Input power for RF section, could connect this pin with VBAT_BB.	
72	NC					
73	NC					
74	GND	GND		GND	Ground.	
75	GND	GND		GND	Ground.	
76	GND	GND		GND	Ground.	
77	GND	GND		GND	Ground.	
78	GND	GND		GND	Ground.	
79	GPIO	GPIO22	1.8V	I/O, PU	Configurable I/O.	2-16mA
80	GPIO	GPIO23	1.8V	I/O, PU	Configurable I/O.	2-16mA
81	GPIO	GPIO19	1.8V	I/O, PU	Configurable I/O.	2-16mA
82	GPIO	GPIO14	1.8V	I/O, PU	Configurable I/O.	2-16mA
83	NC					
84	NC					

85	NC					
86	NC					
87	SDIO1	SDCC1_DATA0	2.6V	I/O	SD data bit 0.	2-8mA
88	SDIO1	SDCC1_DATA1	2.6V	I/O	SD data bit 1.	2-8mA
89	SDIO1	SDCC1_CLK	2.6V	DO	SD clock.	2-16mA
90	GPIO	GPIO3	1.8V	I/O, PU	Configurable I/O.	2-16mA
91	GND	GND		GND	Ground.	
92	NC					
93	SIM	USIM_RST	1.8V/2.85V	DO	UIM reset.	
94	JTAG	JTAG_TDO	2.6V	Z	Test data output.	
95	JTAG	JTAG_TDI	2.6V	DI, PU	Test data input.	
96	power output	VREG_MSMP	2.6V		Pad voltage for digital I/Os.	300mA
97	JTAG	JTAG_TRST_N	2.6V	DI, PD	Reset.	
98	NC					
99	NC					
100	GND	GND		GND	Ground.	
101	USB	USB_D_M		AI,AO	USB differential data I/O, (-) side.	
102	USB	USB_D_P		AI,AO	USB differential data I/O, (+) side.	
103	GND	GND		GND	Ground.	
104	power on key	MSM_PON	1.8V	AI.PU	Connect to the keypad power button.	
105	ADC in	MPP4		AI	Multipurpose pin.	
106	other	D2D_PS_HOLD		DI	Baseband circuits drive this input high to keep power on, low to shut down.	
107	GND	GND		GND	Ground.	
108	GND	GND		GND	Ground.	
109	Speaker	SPKR_OUT_P		AO	Speaker driver (+) output. Connect directly to the speaker.	500mW
110	Speaker	SPKR_OUT_M		AO	Speaker driver (-) output. Connect directly to the speaker.	500mW
111	NC					
112	NC					
113	ADC in	MPP2		AI	Multipurpose pin.	
114	current sink	VIB_DRV_N		AO	Connect to the vibration motor (-) terminal. The (+) terminal of the	

					motor connects to VDD.	
115	ADC in	PA_THERM		AI	Connect to thermistor for PA.	
116	current sink	LCD_DRV_N		AO	LCD backlight current driver.	150mA
117	GND	GND		GND	Ground.	
118	GPIO	GPIO13	1.8V	I/O, PD	Configurable I/O.	2-16mA
119	GPIO	GPIO0	1.8V	I/O, PD	Configurable I/O.	2-16mA
120	GPIO	GPIO12	1.8V	I/O, PD	Configurable I/O.	2-16mA
121	PWM	GP_PDM_0	1.8V	DO,PD	"Backlight"12-bit PDM;XO/4 clock.	2-16mA
122	GND	GND		GND	Ground.	
123	GND	GND		GND	Ground.	
124	GND	GND		GND	Ground.	
125	GND	GND		GND	Ground.	
126	GND	GND		GND	Ground.	
127	GND	GND		GND	Ground.	
128	GND	GND		GND	Ground.	
129	GND	GND		GND	Ground.	
130	GND	GND		GND	Ground.	
131	GND	GND		GND	Ground.	
132	GND	GND		GND	Ground.	
133	GND	GND		GND	Ground.	
134	GND	GND		GND	Ground.	
135	GND	GND		GND	Ground.	
136	GND	GND		GND	Ground.	
137	GND	GND		GND	Ground.	
138	GND	GND		GND	Ground.	
139	GND	GND		GND	Ground.	
140	GND	GND		GND	Ground.	
141	GND	GND		GND	Ground.	

3. RF AIR INTERFACES AND PERFORMANCE

3.1 RF AIR INTERFACE AND BAND CONFIGURATION

3.1.1 Air interfaces

UMC-6055QV module supports CDMA 1xRTT and GPS

3.2 RF PERFORMANCE

The UMC-6055QV modules RF transmitter/receiver is fully compliant with the applicable standards. The sensitivity and max output power are listed in Table 3-2-1 and Table 3-2-2

Specification	Min	Typ	Max	Units
CDMA2000 1X Sensitivity				
BC1 (1930-1990MHz Rx)	-104.7	-108		dBm
BC0 (869-894MHz Rx)	-106.7	-110		dBm
GPS Sensitivity		-155		dBm

Table 3-2-1 Conducted Receiver Sensitivity

Specification	Min	Typ	Max	Units
CDMA2000 1X Output Power				
BC1 (1850-1910MHz Tx)		23.5		dBm
BC0 (824-849MHz Tx)		23.5		dBm
GPS Sensitivity		-155		dBm

Table 3-2-2 Conducted Transmitter Max Output Power

3.3 TRANSMITTER POWER CLASS

The UMC-6055QV Modules support the power classes listed in Table 3-3

Mode	Band	Power Class
CDMA2000 1X	BC1/BC0	3

Table 3-3 Supported Power Classes

4.   OPERATING CONDITIONS

4.1   ABSOLUTE MAXIMUM RATINGS

Operating UMC-6055QV Modules under conditions beyond its absolute maximum ratings (Table 4-1) may damage the device. Absolute maximum ratings are limiting values to be considered individually when all other parameters are within their specified operating ranges. Functional operation and specification compliance under any absolute maximum condition, or after exposure to any of these conditions, is not guaranteed or implied. Exposure may affect device reliability.

Symbol	Parameter	Min	Max	Unit
Ts	Storage temperature	-40	85	C
USB_VBUS	DC power supply voltage	4.5	5.5	V
VBAT	Battery input voltage	3.4	4.2	V
VESD_HBM	Eletrostatic discharging voltage rating (human body model)	*		V
VESD_CDM	Electrostatic discharge voltage rating (charge device model)	*		V
RH_Operating	Operating humidity range	10	90	%
RH_Non-OP	Nonoperating humidity range	5	95	%

*NOTE: ESD protection should be provided external to the module.

Table 4-1 : Absolute maximum ratings

4.2   RECOMMENDED OPERATING CONDITION

The devices meet all performance specifications when used within the recommended operating conditions as described in Table 4-2

Symbol	Parameter	Min	Typ.	Max	Unit
T	Operating Temperature	-25		+85	℃
	Normal operating temperature range See section 4.2.1	-20		+65	℃
	Extended operating temperature range 1 See section 4.2.2	-25		-20	℃
	Extended operating temperature range 2 See section 4.2.3	+65		+85	℃
USB_VBUS	DC Power Supply Voltage	4.75	5	5.25	V
VBAT (Battery)	DC Power Supply Voltage	3.4	3.8	4.2	V

Table 4-2

4.2.1 Normal operating temperature range
The wireless module is fully functional and meets the 3GPP specification across the specified temperature range.

4.2.2 Extended operating temperature range 1
The wireless module is fully functional across the specified temperature range. Occasional deviations from the 3GPP specification may occur.

4.2.3 Extended operating temperature range 2
The wireless module is functional across the specified temperature range. Occasional deviations from the 3GPP specification may occur. Thermal protection including automatic shutdown is implemented for protection against overheating.

5.   CURRENT CONSUMPTION

The specified supply currents in Table 5-1 are based operation at room temperature. Current measurements are taken with default parameter settings, nominal supply voltage. The DUT is mounted on a module test board and the accelerometer on, unless otherwise noted.

Operating Modes	Description	Conditions	Average Current			
			Min	Typ	Max	Unit
Power Down(OFF)	VBAT voltage applied	Power Down*1,2		22		μA
CDMA2000 1X	Between Rx wakeups	Sleep*1,2		1		mA
	Rx awake current	Rx Idle		70		mA
	Average Sleep and Rx	Standby*3		1.4		mA
	Average GPS only	Average GPS only		42		mA
		TX/RX (0dBm)		180		mA
		Tx/Rx (23.5dBm)		550		mA

Table 5-1 Typical Power Consumption

Note 1 Measurement taken without Test Board
Note 2 Measurement taken without Accelerometer
Note 3 Value calculated from measured IUSB_AVG subtacted from
ITOTAL_GPS_AVG, I-GPS = I-Total_GPS_AVG – IUSB_AVG

6. APPLICATION DESIGN NOTES

6.1 Layout Notes

6.2 RF Pin Input Impedance Matching

Applications utilizing the module must ensure that a 50Ω controlled impedance trace is used. Shown in the accompanying table are example calculations for a four- layer FR4 stack up and the resulting trace width for Bluetooth RF input. The figure below illustrates the layer stack up for a four- layer board according to the Description column in the table below.

Layer	Material Type	Dielectric Thickness	Trace Width	Copper Thickness	Dielectric Constant	Char. Impedance	Description
1	Conductive	-	27	2.1	-	50	Microstrip
	Dielectric	16	-	-	4.3	-	Prepreg
2	Conductive	-	-	1.4		-	Plane
	Dielectric	20			4.3	-	Prepreg
3	Conductive	-	-	1.4	-	-	Plane
	Dielectric	16	-	-	4.3	-	Prepreg
4	Conductive	-	27	2.1	-	50	Microstrip

Table 6-1-1-1 Application Board Characteristic Impedance

Figure 6-1-1-1 Application Board Layer Stack Up

6.3 Handling Requirements
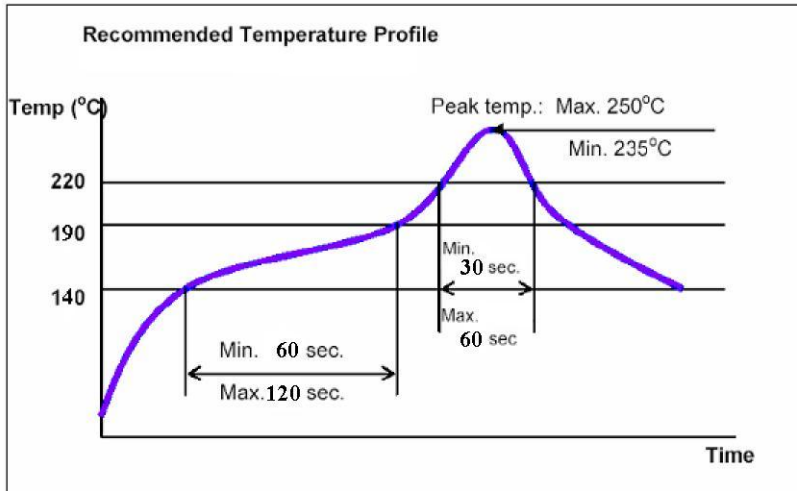
DO NOT TOUCH ANY Pad OF BTI MODULE WHILE ASSEMBLYING.

6.4 Soldering Requirements

Soldering Iron Soldering
 Solder Temperature: 350oC
Immersion Duration: 2 ~ 3 seconds

6.1.3   Reflow Profile

Recommended Temperature Profile

Peak temp.: Max. 250°C

Temp (^{o}C)

Min. 235°C

220

190

Min.
30 sec.

140

Max.
60 sec

Min.   60 sec.

Max.120 sec.

Time

Peak Temperature: 235 ~ 250 Degree Celcius
Reflow Zone (above 220°C): 30~60 sec.
Preheat Zone (140 to 190°C): 60~120 sec.

7. MECHANICAL REQUIREMENTS

7.1 Module Dimension and Footprint
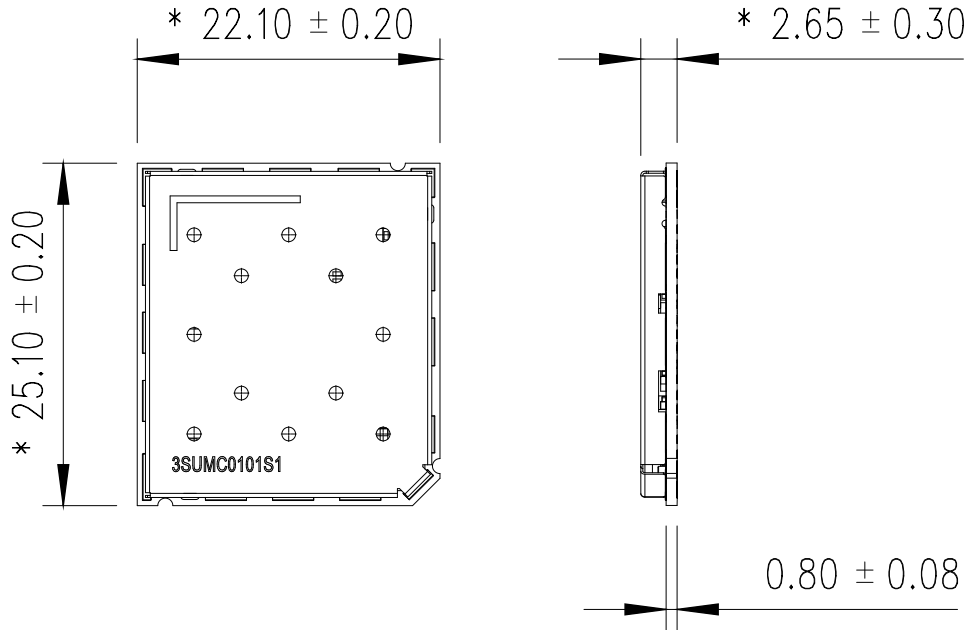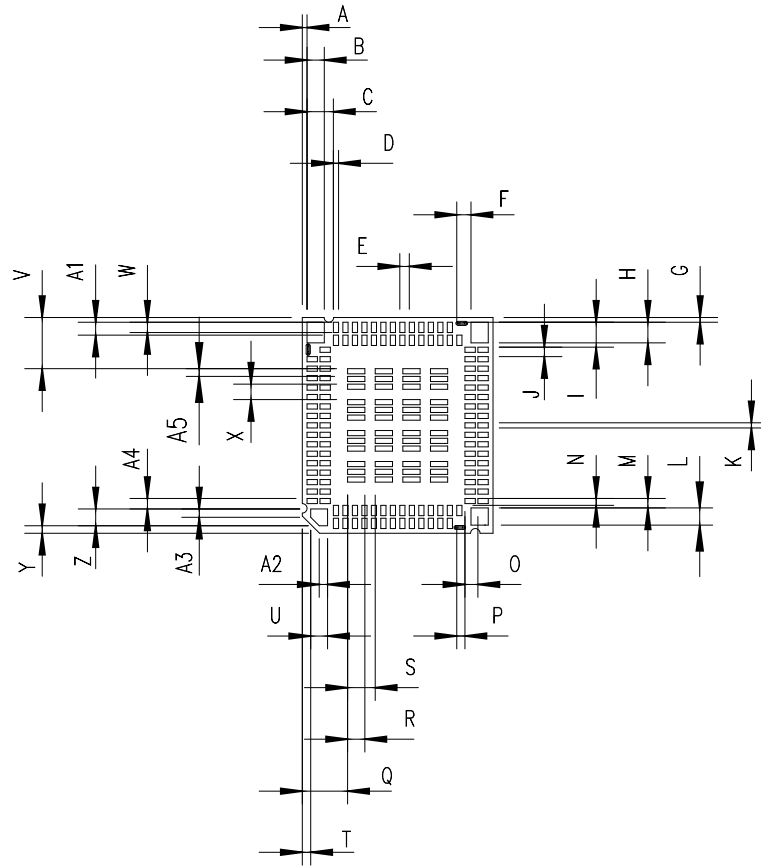
The dimension of this module:

Figure 7-1-1 Dimension of SFF Module

FOOTPRINT

Parameter	Description	Min.	Typ.	Max.	Units
A	Edge to Pin	TBD	0.5	TBD	mm
B	Pin width	TBD	2.0	TBD	mm
C	Pin to Pin Pitch	TBD	3.05	TBD	mm
D	Pin width	TBD	0.6	TBD	mm
E	Pin to Pin Pitch	TBD	1.10	TBD	mm
F	Pin to Pin Pitch	TBD	1.65	TBD	mm
G	Edge to Pin	TBD	0.50	TBD	mm
H	Edge width	TBD	2.40	TBD	mm
I	Pin to Pin Pitch	TBD	2.90	TBD	mm
J	Pin to Pin Pitch	TBD	1.10	TBD	mm
K	Pin width	TBD	0.6	TBD	mm
L	Pin width	TBD	2.0	TBD	mm
M	Pin to Pin Pitch	TBD	1.10	TBD	mm
N	Pin to Pin Pitch	TBD	0.80	TBD	mm
O	Pin to Pin Pitch	TBD	1.50	TBD	mm
P	Pin to Pin Pitch	TBD	0.95	TBD	mm
Q	Edge to Pin	TBD	5.20	TBD	mm
R	Pin width	TBD	2.0	TBD	mm
S	Pin to Pin Pitch	TBD	3.20	TBD	mm
T	Edge to Pin	TBD	0.925	TBD	mm
U	Pin width	TBD	1.95	TBD	mm
V	Edge to Pin	TBD	5.90	TBD	mm
W	Pin width	TBD	1.20	TBD	mm
X	Pin to Pin Pitch	TBD	1.80	TBD	mm
Y	Edge to Pin	TBD	0.825	TBD	mm
Z	Pin width	TBD	1.95	TBD	mm
A1	Pin to Pin Pitch	TBD	1.50	TBD	mm
A2	Pin to Pin Pitch	TBD	0.96	TBD	mm
A3	Pin to Pin Pitch	TBD	0.96	TBD	mm
A4	Pin to Pin Pitch	TBD	1.225	TBD	mm
A5	Pin to Pin Pitch	TBD	0.80	TBD	mm

Figure 7-1-2 Recommended Footprint of SFF Module

8 Certification Requirements

8.1 Carrier Certification Requirements

The SFF Development Kit will be used to demonstrate Safe for Network (SFN) compliance for the SFF module on selected cellular carriers.

8.2 Regulatory Compliance [5]

Specification	Support	Comments
UL Listed	Yes	Only for DC adapter and battery. Not required for Rigel, Orion and Bellatrix.
RoHS Compliant	Yes	
FCC CFR 47 Part 2 Compliant	Yes	(Subparts C, I & J)
FCC CFR 47 Part 15 Compliant	Yes	(Subparts B & C)
ESD Certified	Yes	EC 61000-4-2 HBM

8.3 FCC warning statement

FCC Regulations:

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 interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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 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 Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Radiation Exposure Statement:

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 & your body.

This device is intended only for OEM integrators under the following conditions:

1)   The antenna must be installed such that 20 cm is maintained between the antenna and users, and the antenna type and gain allowed for use with this device is type: fixed external; max. gain: 2dBi.

2)   The transmitter module may not be co-located with any other transmitter or antenna.

As long as 2 conditions above are met, further <u>transmitter</u> test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed

IMPORTANT NOTE: In the event that these conditions <u>can not be met</u> (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID <u>can not</u> be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

End Product Labeling
This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: "Contains FCC ID: **NKRUMC-6055Q**". The grantee's FCC ID can be used only when all FCC compliance requirements are met.

Manual Information To the End User
The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

The end user manual shall include all required regulatory information/warning as show in this manual.