

## INTRODUCTION

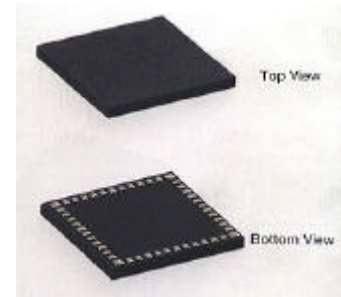
S1M8662A is CDMA/PCS/GPS Triple Mode IF/ baseband IC which is divided into three main parts - IF frequency processing, basband processing , and digital interface. The receiver IC (S1M8662A)and transmitter IC (S1M8657) are provided as a KIT.

S1M8662A is a receiver IC, installed with a Rx AGC, Baseband Converter, Baseband analog filter, and A-D Converter. It can send a digital baseband signal to the digital baseband IC.

S1M8662A is fabricated on the Samsung's 0.5um high-speed, high frequency BICMOS processing and can achieve superior high frequency and low power digital operations.

Its operating voltage is 2.7 to 3.3V, and operating temperature -30 to +85°C .

32-BCC++-5.0x5.0



## FEATURES

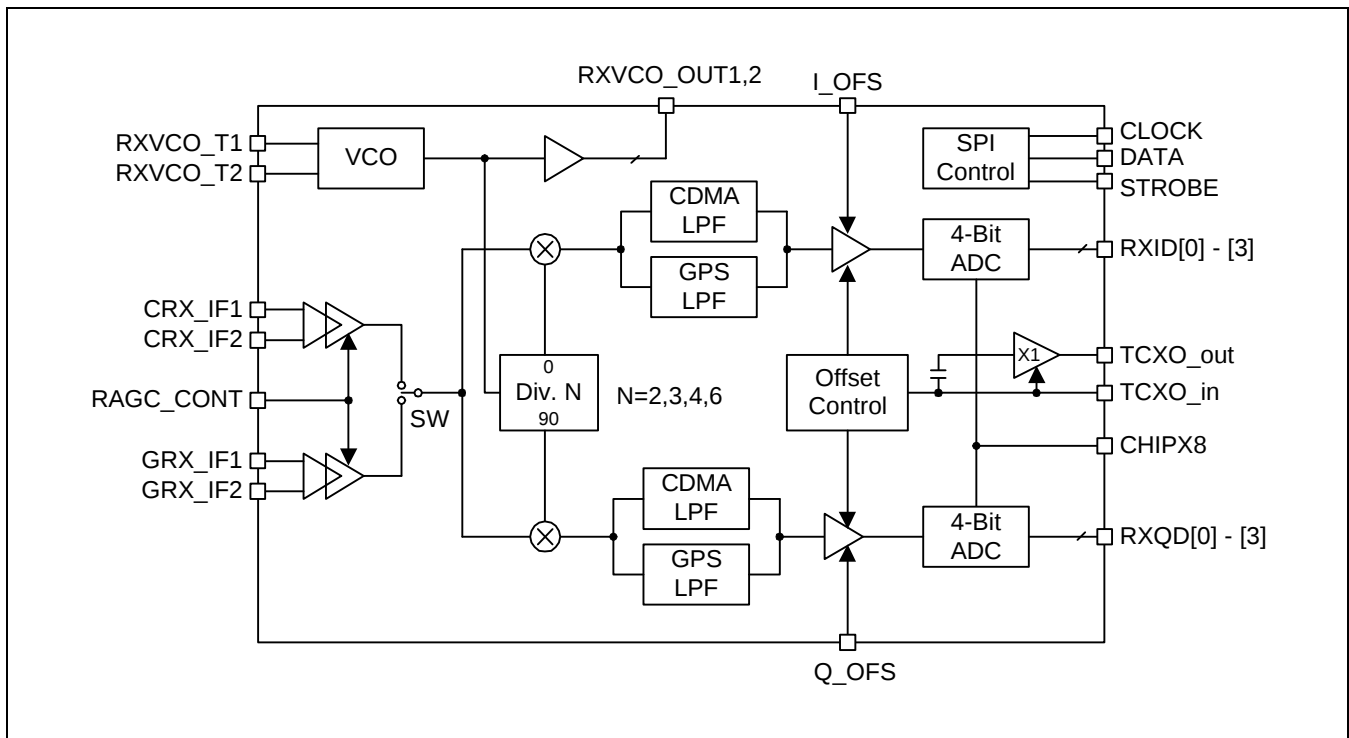
- Cellular CDMA/PCS/GPS Triple Mode
- AGC input signal range : 90dB
- QPSK Baseband Converter
- Built-in I ,Q Baseband signal extractor LPF
- Built-in 4-bit ADC for converting I and Q CDMA analog baseband signals to digital baseband signals
- Built-in VCO for baseband conversion
- Built-in Modem PDM control circuit to compensate the I and Q offsets
- Built-in TCXO output ON/OFF
- 3-Line Serial Port Interface (SPI)
- Operating Voltage : 2.7 to 3.3V
- 32BCC++(5mm \* 5mm \* 0.8mm) Package

## ORDERING INFORMATION

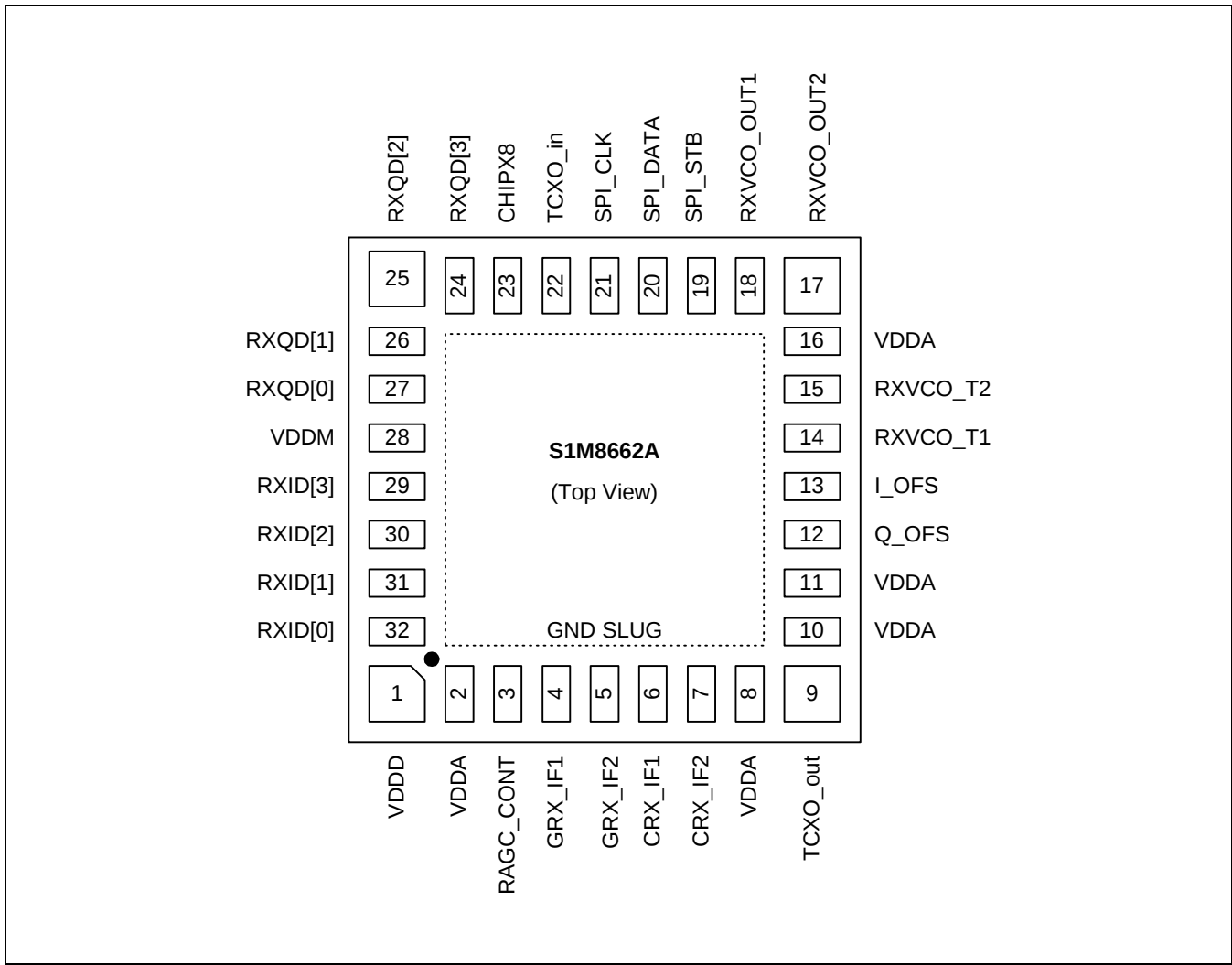
| Device              | Package          | Operating Temperature |
|---------------------|------------------|-----------------------|
| ++ S1M8662AX01-F0T0 | 32-BCC++-5.0x5.0 | -30 to +85°C          |

++ : Under Development

## BLOCK DIAGRAM



PIN CONFIGURATION



## PIN DESCRIPTION

| Pin No   | Symbol                   | I/O   | Description                                                                                                                                                                                                                                                  |
|----------|--------------------------|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1        | VDDD                     | P     | Power for the digital logic.                                                                                                                                                                                                                                 |
| 2        | VDDA                     | P     | Power input terminal for the analog circuit.                                                                                                                                                                                                                 |
| 3        | RAGC_CONT                | AI    | AGC gain control input. The input voltage is allowed up to VDDA. It remains at High impedance during SLEEP.                                                                                                                                                  |
| 4<br>5   | GRX_IF1<br>GRX_IF2       | AI    | GPS IF input terminals, which have an input impedance of about 865Ω; generally, the GPS IF SAW filter is connected to them. When these terminals are not used, they remain at High impedance.                                                                |
| 6<br>7   | CRX_IF1<br>CRX_IF2       | AI    | CDMA IF input terminals, which have an input impedance of about 865Ω; generally, the CDMA IF SAW filter is connected to them. When these terminals are not used, they remain at High impedance.                                                              |
| 8        | VDDA                     | P     | Power input terminal for the analog circuit.                                                                                                                                                                                                                 |
| 9        | TCXO_out                 | DO    | TCXO Clock output. division ratio : 1                                                                                                                                                                                                                        |
| 10       | VDDA                     | P     | Power input terminal for the analog circuit.                                                                                                                                                                                                                 |
| 11       | VDDA                     | P     | Power input terminal for the analog circuit.                                                                                                                                                                                                                 |
| 12<br>13 | Q_OFS<br>I_OFS           | AI    | Control DC input for removing the DC offset generated in the S1M8662A and system during CDMA and GPS Mode. The control DC is generated in the modem in PDM form, passes through the R-C filter and is converted to DC, which is sent to this input terminal. |
| 14<br>15 | RXVCO_T1<br>RXVCO_T2     | AI    | Very sensitive terminal, which is connected to the oscillation L-C resonance circuit.<br>Their impedance are about 2kΩ                                                                                                                                       |
| 16       | VDDA                     | P     | Power input terminal for the analog circuit.                                                                                                                                                                                                                 |
| 17<br>18 | RXVCO_OUT1<br>RXVCO_OUT2 | AO    | Output for the PLL, able to output about -12dBm.<br>When this is not used, it remains at high impedance.                                                                                                                                                     |
| 19       | SPI_STB                  | DI    | 3-Line serial control. Strobe input port.<br>If this pin is opened, it remains at Low.                                                                                                                                                                       |
| 20       | SPI_DATA                 | BI    | 3-Line serial control. DATA input/output port.<br>If this pin is opened, it remains at Low.                                                                                                                                                                  |
| 21       | SPI_CLK                  | DI    | 3-Line serial control. CLOCK input/output port.<br>If this pin is opened, it remains at Low.                                                                                                                                                                 |
| 22       | TCXO_in                  | AI/DI | Reference frequency input terminal connected to the VCTCXO output. When this pin stops, only DC bias is delivered to maintain the DC charge value of the capacitor connected externally                                                                      |
| 23       | CHIPx8                   | DI    | CHIPx8 Clock input port. CDMA/GPS ADC sampling clock from the MSM.                                                                                                                                                                                           |

**PIN DESCRIPTION (Continued)**

| Pin No               | Symbol                           | I/O | Description                                                                                                                                                                                                                                                           |
|----------------------|----------------------------------|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 24<br>25<br>26<br>27 | RXQD3<br>RXQD2<br>RXQD1<br>RXQD0 | DO  | Q Channel 4-bit A-D Converter's digital outputs, which are connected to the modem data input pins. These data are synchronized at CHIP×8's rising edge and output. Because they are valid at the falling edge, the data are latched at the falling edge in the modem. |
| 28                   | VDDM                             | DI  | Power source for a logic circuit ,related to the digital input /output, connected to an external digital logic such as the modem.                                                                                                                                     |
| 29<br>30<br>31<br>32 | RXQD3<br>RXQD2<br>RXQD1<br>RXQD0 | DO  | I Channel 4-bit A-D Converter's digital outputs, which are connected to the modem data input pins. These data are synchronized at CHIP×8's rising edge and output. Because they are valid at the falling edge, the data are latched at the falling edge in the modem. |

**Table 1. S1M8660A and S1M8662A Function & Control Content Comparison**

| Function / Mode Control                                                                                                                     | S1M8660A    | S1M8662A             |
|---------------------------------------------------------------------------------------------------------------------------------------------|-------------|----------------------|
| Operation Modes<br>CDMA (Cellular CDMA, PCS)<br>AMPS (FM)<br>Global Positioning System (GPS)                                                | •<br>•<br>• | •<br>•<br>•          |
| IF AGC 90dB Range<br>CDMA (Cellular CDMA, PCS)<br>AMPS (FM)<br>Global Positioning System (GPS)                                              | •<br>•<br>• | •<br>•<br>•          |
| IF to Analog Baseband Quadrature Down-Conversion<br>CDMA (Cellular CDMA, PCS)<br>AMPS (FM)<br>Global Positioning System (GPS)               | •<br>•<br>• | •<br>•<br>•          |
| Low Pass Baseband I/Q Filtering with Mode Specific Performance<br>CDMA (Cellular CDMA, PCS)<br>AMPS (FM)<br>Global Positioning System (GPS) | •<br>•<br>• | •<br>•<br>•          |
| 4-bit I/Q Analog to Digital Converters, Parallel Outputs<br>CDMA (Cellular CDMA, PCS)<br>Global Positioning System (GPS)                    | •<br>•      | •<br>•               |
| 8-bit I/Q Analog to Digital Converters, Serial Outputs<br>AMPS (FM)                                                                         | •           |                      |
| Rx Slotting Operation for Saving Current Consumption                                                                                        | •           | •                    |
| Clock Generation<br>TCXO/N Output<br>Configurable CHIPx8 as Input or Output                                                                 | •<br>•      | Δ (N=1)<br>Δ (Input) |
| VCO for Generation the Rx IF LO                                                                                                             | •           | •                    |
| Analog Baseband Amplifiers with I/Q Offset Controls                                                                                         | •           | •                    |

**ABSOLUTE MAXIMUM RATINGS**

| Characteristic                 | Symbol    | Value         |
|--------------------------------|-----------|---------------|
| Power supply                   | $V_{CC}$  | -0.5 to 3.6V  |
| Storage temperature            | $T_{STG}$ | -55 to +125°C |
| Operating temperature          | $T_{OPR}$ | -30 to +85°C  |
| Storage temperature            | HBM       | TBD           |
| Electrostatic discharge rating | MM        | TBD           |

**RECOMMENDED OPERATING CONDITIONS**

| Characteristic                | Symbol             | Value        |
|-------------------------------|--------------------|--------------|
| Power supply                  | $V_{DDA}, V_{DDD}$ | 2.7 to 3.3V  |
|                               | $V_{DDM}$          | 2.4 to 3.3V  |
| Ambient operating temperature | $T_a$              | -30 to +85°C |

**ELECTRICAL CHARACTERISTICS**Electrical Characteristics( $V_{CC} = 3.3V$ ,  $T_a = 25^\circ C$ )

| Characteristic                  | Test Conditions     | Symbol     | Min           | Typ | Max | Units |
|---------------------------------|---------------------|------------|---------------|-----|-----|-------|
| Current consumption             | CDMA idle mode      | $I_{CRX}$  | -             | 23  | 30  | mA    |
| Current consumption             | CDMA sleep mode     | $I_{CSLP}$ | -             | 300 | 650 | uA    |
| Current consumption             | CDMA slot mode      | $I_{CSLT}$ | -             | 5   | 7   | mA    |
| Current consumption             | GPS idle mode       | $I_{GPS}$  | -             | 24  | 31  | mA    |
| Logic high input                |                     | $V_{IH}$   | $V_{DDM}-0.4$ | -   | -   | V     |
| Logic low input                 |                     | $V_{IL}$   | -             | -   | 0.4 | V     |
| Logic high output               |                     | $V_{OH}$   | $V_{DDM}-0.4$ | -   | -   | V     |
| Logic low output                |                     | $V_{OL}$   | -             | -   | 0.4 | V     |
| Digital input capacitance       |                     | $C_{DI}$   | -             | -   | 5   | pF    |
| Digital output load capacitance |                     | $C_{DOL}$  | -             | -   | 10  | pF    |
| TCXO input impedance            | Attach C = 2pF      | $Z_{TCXO}$ | 10            | -   | -   | kΩ    |
| VCO input resistance            | IF VCO differential | $R_{VCO}$  | -             | 2.0 | -   | kΩ    |
| VCO input capacitance           | IF VCO differential | $C_{VCO}$  | -             | -   | 2   | pF    |

## AC Characteristics

| Characteristic                     | Test Conditions                                                                                                                                                                                                                                                                                                                                                                   | Symbol     | Min  | Typ | Max   | Unit |
|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------|-----|-------|------|
| <b>CDMA Performance</b>            |                                                                                                                                                                                                                                                                                                                                                                                   |            |      |     |       |      |
| Input sensitivity                  | Maximum AGC gain. Control input signal so that output corresponding to 3LSB is output from ADC.                                                                                                                                                                                                                                                                                   | VCSEN      | -102 | -   | -     | dBm  |
| Maximum input signal               | Minimum AGC gain. Control input signal so that output corresponding to 3LSB is output from ADC.                                                                                                                                                                                                                                                                                   | VCMAX      | -    | -   | -12   | dBm  |
| AGC gain slope                     | PDM 3.3V Mode                                                                                                                                                                                                                                                                                                                                                                     | GS<br>LOPE | 43   | 50  | 57    | dB/V |
| AGC gain error over temperature    | -30 to +85°C.                                                                                                                                                                                                                                                                                                                                                                     | GVAR       | -3   | -   | 3     | dB   |
| IF input frequency range           | Cin < 2pF                                                                                                                                                                                                                                                                                                                                                                         | Fin        | -    | -   | 250   | MHz  |
| IF input Impedance                 |                                                                                                                                                                                                                                                                                                                                                                                   | Zin        | 0.8  | 1.0 | 1.2   | kΩ   |
| Noise figure                       | Input power = -102dBm                                                                                                                                                                                                                                                                                                                                                             | NFmin      | -    | -   | 7     | dB   |
|                                    | Input power = -75dBm                                                                                                                                                                                                                                                                                                                                                              | NFmid      | -    | -   | 20    | dB   |
|                                    | Input power = -25dBm                                                                                                                                                                                                                                                                                                                                                              | NFmax      | -    | -   | 72    | dB   |
| IIP3                               | AGC gain Max.                                                                                                                                                                                                                                                                                                                                                                     | IIP3max    | -53  | -   | -     | dBm  |
|                                    | AGC gain Min.                                                                                                                                                                                                                                                                                                                                                                     | IIP3min    | -10  | -   | -     | dBm  |
| Spurious contents                  | ADC generated harmonic frequency component. Two signals in the in-band are each mixed with signals which will allow ADC to produce -7dB output signals. The harmonic and non-harmonic components of the ADC output signals between 1kHz to 20MHz are extracted and added. The AGC control voltage is controlled so that ADC output is full scale when the input signal is -80dBm. | TSpur      | -    | -   | -25   | dBc  |
| Spurious content related to jammer | In-band spurious peak value produced by IMD based on 2 jammer signals. One in-band signal(@50kHz,0.5*F/S) and two jammers(@900kHz, 22dB*F/S and @1.7MHz, 21dB*F/S)are simultaneously input. AGC control voltage is controlled so that ADC output is F/S when the input signal is -80dBm.                                                                                          | Jspur      | -    | -   | -18.4 | dBc  |

## AC Characteristics (Continued)

| Characteristic                          | Test Conditions                                                                                                                                                                          | Symbol | Min | Typ | Max | Unit   |
|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-----|-----|-----|--------|
| Single-tone jammer desense              | Overall gain reduction due to one jammer. The in-band signal at -97dBm (control the AGC control voltage to 0.5*F/S) and the jammer signal at 900kHz and -57dBm are simultaneously input. | Jdsen  | -   | -   | 1.0 | dB     |
| Residual Sideband                       | $RSB = 20 \log \sqrt{\frac{1 + k^2 + 2k \cos q}{1 + k^2 - 2k \cos q}}$ k : Linear Gain Mismatch<br>q : Phase Mismatch in Deg.                                                            | RSB    | 22  |     |     | dB     |
| Offset gain slope                       | Amount of code change of the voltage ADC output at the I/Q offset control                                                                                                                | GOFS   | -   | 250 | -   | %FS/V  |
| Offset adjust input impedance           | -                                                                                                                                                                                        | Zoff   | 100 | -   | -   | kΩ     |
| Out-band attenuation                    | ≥ 900kHz                                                                                                                                                                                 | ATC9   | 46  | -   | -   | dB     |
|                                         | ≥ 1.2MHz                                                                                                                                                                                 | ATC12  | 48  | -   | -   | dB     |
| Gain flatness                           | Amount of gain change along I and Q paths between 1kHz to 615kHz                                                                                                                         | Gft    | -1  |     | 1   | dB     |
| <b>IF VCO performance</b>               |                                                                                                                                                                                          |        |     |     |     |        |
| VCO and buffered output Frequency range | VCO external time constant and PLL value                                                                                                                                                 | Fvco   | -   | 170 | 500 | MHz    |
| VCO phase noise                         | Tank LC's Q value should be above 20. Measure @100kHz away from the mid-frequency.                                                                                                       | Pvco   | -   | -   | 104 | dBc/Hz |
| RXVCO_OUT output power                  | Select a VCO buffer output value reduced by -2dB. Connect output load to 50Ω.                                                                                                            | Ovco   | -15 | -   | -   | dBm    |

## AC Characteristics (Continued)

| Characteristic                  | Test Conditions                                                                                                       | Symbol  | Min  | Typ | Max | Unit  |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------|---------|------|-----|-----|-------|
| <b>GPS Performance</b>          |                                                                                                                       |         |      |     |     |       |
| Input sensitivity               | Maximum AGC gain. Control input signal so that ADC outputs 0.5*F/S.                                                   | VCSEN   | -102 | -   | -   | dBm   |
| Maximum input signal            | Minimum AGC gain Control input signal so that ADC outputs 0.5*F/S.                                                    | VCMAX   | -    | -   | -12 | dBm   |
| AGC gain slope                  | PDM 3.3V Mode                                                                                                         | GSLOPE  | 43   | 50  | 57  | dB/V  |
| AGC gain error over temperature | -30°C to +85°C.                                                                                                       | GVAR    | -3   | -   | 3   | dB    |
| IF input frequency range        | Cin < 2pF                                                                                                             | Fin     | -    | -   | 250 | MHz   |
| IF input Impedance              |                                                                                                                       | Zin     | 0.8  | 1.0 | 1.2 | kΩ    |
| Noise figure                    | Input power = -98dBm                                                                                                  | NFmin   | -    | -   | 7   | dB    |
|                                 | Input power = -75dBm                                                                                                  | NFmid   | -    | -   | 12  | dB    |
|                                 | Input power = -25dBm                                                                                                  | NFmax   | -    | -   | 58  | dB    |
| IIP3                            | AGC gain Max.                                                                                                         | IIP3max | -53  | -   | -   | dBm   |
|                                 | AGC gain Min.                                                                                                         | IIP3min | -25  | -   | -   | dBm   |
| Offset gain slope               | Amount of code change of the voltage ADC output at the I/Q offset control                                             | GOFS    |      | 250 |     | %FS/V |
| Offset adjust input impedance   | -                                                                                                                     | Zoff    | 100  | -   | -   | kΩ    |
| Out-band attenuation            | ≥ 1.3MHz                                                                                                              | ATC13   | 46   | -   | -   | dB    |
|                                 | ≥ 1.7MHz                                                                                                              | ATC17   | 48   | -   | -   | dB    |
| Residual Sideband               | $RSB = 20 \log \sqrt{\frac{1+k^2+2k \cos q}{1+k^2-2k \cos q}}$ k : Linear Gain Mismatch<br>q : Phase Mismatch in Deg. | RSB     | 22   | -   | -   | dB    |
| Gain flatness                   | Amount of gain change along I and Q paths between 1kHz to 800kHz                                                      | Gft     | -1.5 | -   | 1.5 | dB    |

## TIMING DIAGRAMS

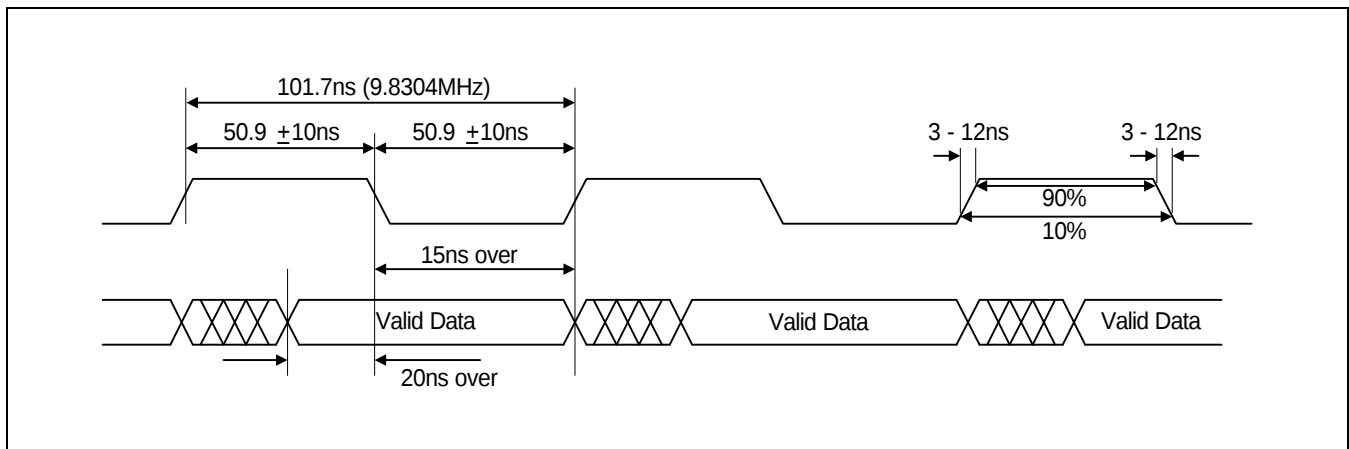


Figure 1. CDMA Receive ADC Timing

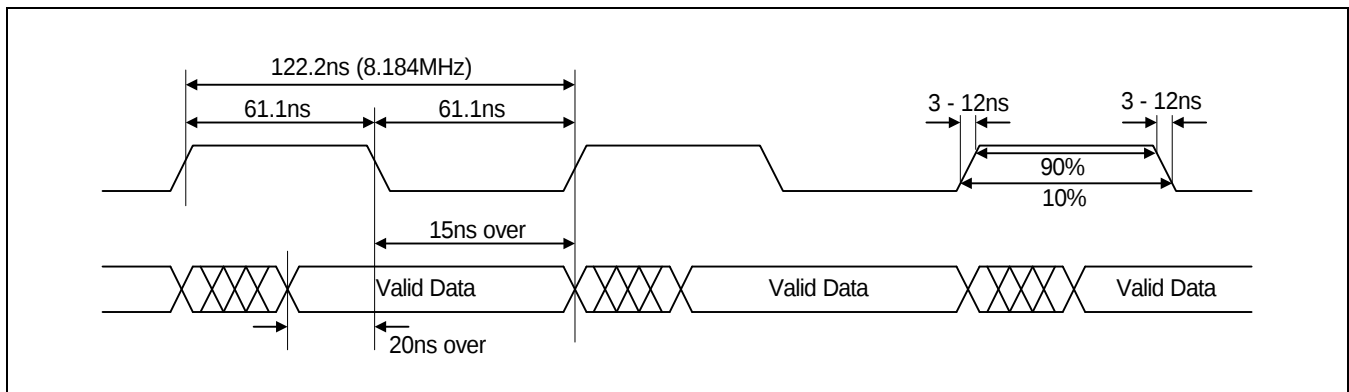


Figure 2. GPS Receive ADC Timing

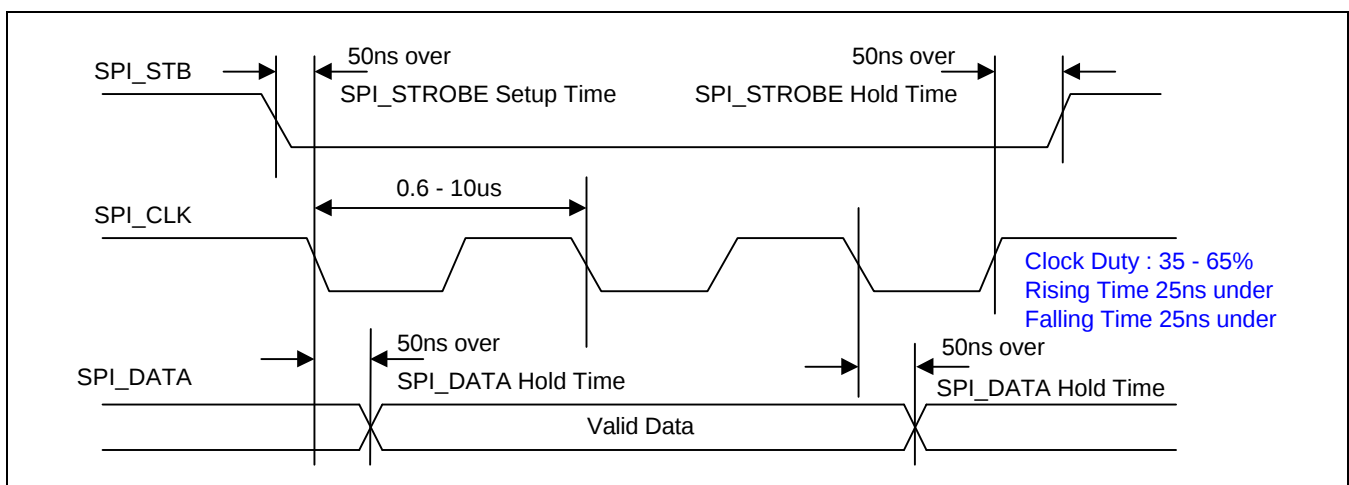


Figure 3. 3-Line Serial Port Interface Timing

## FUNCTIONAL DESCRIPTION

S1M8662A is a CDMA/GPS receive-only baseband analog IC, located between the RF mid-frequency processing terminal and baseband processing terminal. The RF analog mid-frequency signal terminal(IF SAW filter output), directly connected to the S1M8662A mid-frequency input pin, converts and processes the baseband signal and sends the corresponding digital signal to the modem IC. Baseband analog processing uses QPSK modulation, LPF, and A-D converter and the modem IC performs digital CDMA /GPS baseband modulation on the digitalized analog baseband signal it receives. An on-chip VCO creates a multiple frequency(x2, x3, x4, x6) LO signal.

S1M8662A uses a 0.5um BiCMOS, equipped with high-frequency bipolar and low power standardized CMOS logic, to operate safely in the low power range, consisting of power voltage between 2.7 to 3.3V and operating temperature between -30 to +85°C.

### CDMA Receive Signal Path

The receive circuit of S1M8662A has the Rx AGC, an automatic gain controller, and baseband LPF and output terminal with the A-D converter, and VCO and mixer etc. The input signal is received as a differential signal, which is modulated to 1.23 MHz spread-spectrum for CDMA. The mid-frequency is 220.38MHz for Korea-PCS, 1.23MHz for US-PCS, and 85.38MHz for cellular; they are set based on the time constants of the components involved with the external VCO and external Rx PLL. Rx AGC, connected to both the IF SAW filter and matching component in the RF-IF converter output located in the RF block, amplifies or reduces according to the signal size. It takes its orders from the modem chip when it sets the appropriate receive level as required by the CDMA system. Gain is controlled by applying a DC voltage to the RAGC\_CONT pin. The applied DC is produced when the PDM signal, generated as a control signal in the modem, passes through the R-C filter. The control band of this AGC is approx. 90dB. The QPSK Baseband modulator separates and modulates the IF signal sent by the AGC using I(In-phase) and Q(Quad-phase) baseband signal. Essentially, two signals, I-LO and Q-LO (Local oscillator), are mixed with AGC's IF output signals, respectively. The LO(local oscillator) signal is generated by the internal oscillating components, externally connected tank coil, and Varactor, and the externally independent PLL device is used to generate its exact oscillation mid-frequency.

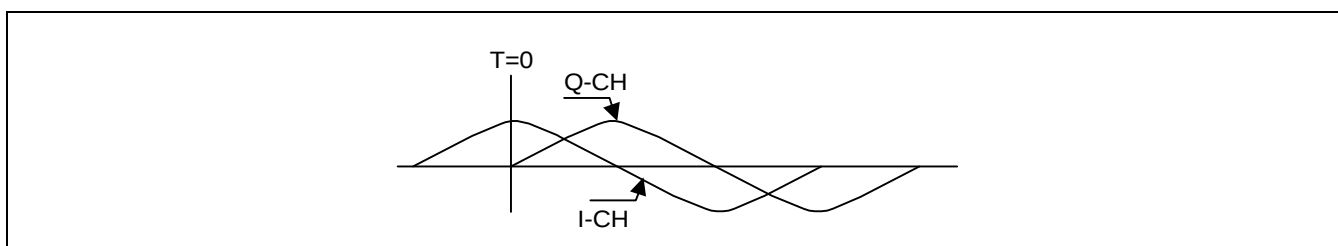


Figure 4. Received I/Q Phase in S1M8662A

Defining of the I-Phase and Q-Phase receive path is very important to its design. The polarities of these paths are also important to digital baseband modulation. Therefore, the output of the QPSK baseband modulation determines the I and Q phases; I-phase is defined as the phase leading the Q-phase by exactly 90°, but it simpler to think of I as Cosin and Q as Sin. The figure related to this is shown in Figure 5. This definition is valid only when the QPSK IF input signal is higher than the IF mid-frequency. The baseband signal, output by the QPSK modulator, includes various other unnecessary surrounding band noises, which are removed by the use of the LPF(Low-Pass-Filter).

Ultimately, I and Q filtered signals are converted to digital signals by the 4-bit A-D converter and sent to the modem. The A-D converter used is a parallel output type and its outputs are synchronized at the CHIP×8 rising edge. The modem chip captures the data on the CHIP×8 falling edge. The CHIP×8 clock used in the A-D converter received to MSM.

### GPS Rx Signal Path

The difference of the S1M8662A from the S1M8656A is that S1M8662A provides GPS receiving operation. While GPS receiving path shares function blocks with CDMA modes, it needs independent AGC and lowpass filter.

GPS IF signal from GPS RF-IF mixer is applied to S1M8662A via GPS SAW filter. GPS IF is differential input pins.

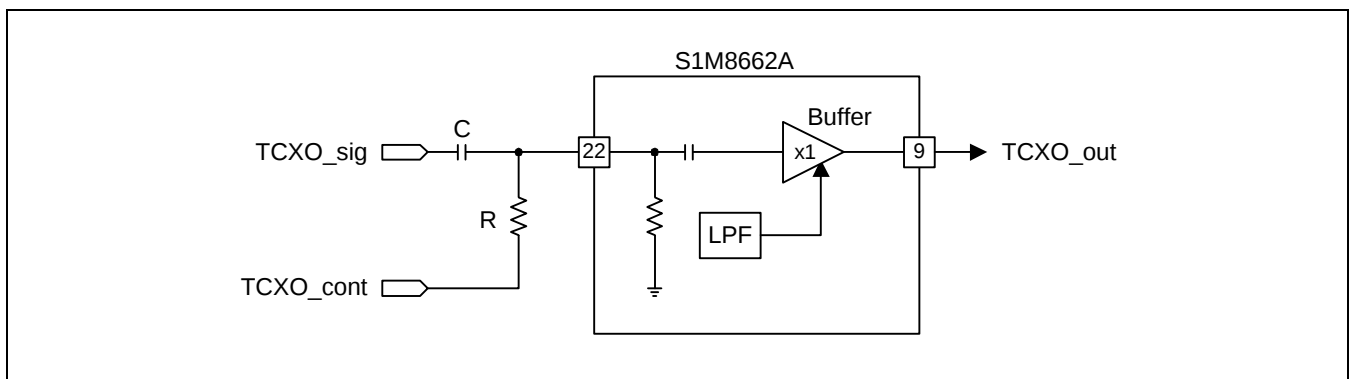
The operation of I/Q demodulator is the same in CDMA modes and the phase relation of I/Q signal of the output is the same as depicted in Figure 5.

GPS lowpass filter of S1M8662A has its cut off frequency at around 800kHz.

A-D converter, as output of GPS path, is the 4bit parallel converter which is the same one used in CDMA path. But the sampling frequency is different from that of CDMA mode. And in operating in GPS mode, sampling clock of A-D converter should be supplied from the modem.

### TCXO Clock Generator

In S1M8656A and S1M8660A, the output of TCXO is divided by 1, 2, and 4 and then clocked out. But in S1M8662A the output of TCXO is just amplified and clocked out. So, there is no SPI control which controls the division ratio of TCXO clock. In this product, the TCXO\_in pin can input both TCXO signal (TCXO\_sig) and TCXO control (TCXO\_cont) at the same time.



**Figure 5. TCXO Clock Generating**

If TCXO\_cont pin is held low or high-impedance (floating), TCXO\_out keeps high, and on the contrary, if TCXO\_cont pin is held high, TCXO\_out outputs TCXO clock. If TCXO\_cont pin is low or high-impedance (floating), S1M8662A can be pin to pin compatible with IFR3500 of Qualcomm.

## RX VOLTAGE CONTROLLED OSCILLATOR(VCO)

S1M8662A includes the Rx LO block having the VCO and quad-phase generator. The quad-phase generator outputs I-phase and Q-phase clocks with 1/2, 1/3, 1/4 or 1/6 the VCO frequency and sends them to the QPSK modulator. The VCO buffer is used when the VCO output is sent to the external RX PLL. Although the allowable VCO frequency is determined based on an external time constant, it can only range between approx. 100MHz to 500MHz, suggesting that the maximum input IF frequency is 250MHz.

## Serial Port Interface(SPI)

S1M8662A is equipped with the Serial I/F. All internal functions can be controlled through a common bus using an external controller. S1M8662A is designed to be completely compatible with MSM series of Qualcomm. Here, the modem is the master and S1M8662A the slave.

Each pin which uses the SPI bus has the following common functions.

- The STB(STROBE) for the serial bus start signal is used to initialize serial data transmission.
- Serial BUS DATA is used for the bi-direction data input /output at serial data transmission. Because it is an open drain type pin, it requires the pull-up resistance of approx. 8k $\Omega$ .
- Serial BUS CLK is used to synchronize the data input/output at serial data transmission.

## Serial Port Interface Operation

The modem, the master, controls slaves such as S1M8662A using the SPI bus.

The STB falling edge indicates the start of the serial I/F data transmission. The STB becomes high to mark the end of the data transmission.

(Data sent after the STB turns high are not valid.)

Serial line data is captured and stored as soon as the BBA or the MODEM places the clock on the falling edge.

The SPI 3-line must remain high for at least 1-clock cycle in order to sent new data.

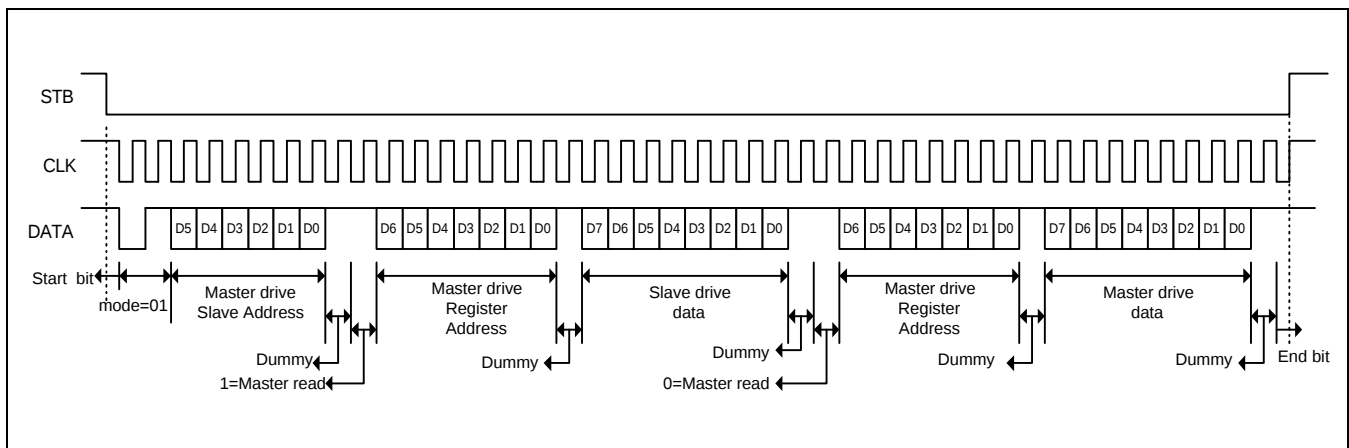
The MSB always outputs the data line data.

After 9-clocks, which is required to send data, the data line driver opens the data line, at which time the data line becomes high because of the external pull-up resistance.

## Serial Data Transfer format

S1M8662A and S1M8657 are all slave devices with the SPI bus. What differentiate them from one another is their different device IDs. Each company has its own characteristic SPI bus configuration , but normally the 3-line bus is most often used and sometimes the 2-line bus such as the IIC bus.

Figure 7. shows the serial data transfer format.



**Figure 6. Serial Data Transfer Format**

- (1) The first 2-BITs are for transmission only and this product must send '01'.(Others are not permitted.)
- (2) The following 6-bit data specifies the slave device, which is connected to the SPI bus and has its own ID.
- (3) The following 1-bit is a dummy bit, which marks the end of the 8-bit data transmission and the beginning of the next data to be sent.
- (4) The following 1-bit decides on whether the master will drive the data line or the slave will. If this bit is '1', the master will drive , but if '0' the slave will drive the data line.
- (5) The following 7-bit data is the register address of the specified slave device; the 7-bits for an address allows 128 register addresses for slaves.
- (6) The following high 1-BIT data is a dummy data.
- (7) The following 8-BIT data is the data in the device to be driven.
- (8) The following 1-BIT data is a dummy data, which marks the end of the 8-bit data transmission and beginning of the next data to be sent.
- (9) The following 1-bit decides on whether the master will drive the data line or the slave will. If this bit is '1', the master will drive , but if '0' the slave will drive the data line.
- (10) The following 7-bit data is the register address of the specified slave device.
- (11) The following high 1-BIT data is a dummy data.
- (12) The following 8-BIT data is the data in the device to be driven.  
(Continous data transmission such as this can be ended with a 1-byte transmission or can be read/written repeatedly.)
- (13) After the last data is sent, the data line opens and becomes high;
- (14) the CLK continues for half the 1-clock cycle and then becomes high;
- (15) and the STB becomes high as soon as the clock becomes high and this marks the end of data transmission.

## Modes of Operation

S1M8662A can be controlled by the SPI bus.  
Table 2 shows the various modes.

**Table 2. Mode control in the DC control mode**

| Mode          | 0x03[1:0]<br>BLOCK_CTL | 0x06[7]<br>VCO_CTL | 0x052:0]<br>FILTER_SEL | CHIPx8                                            |
|---------------|------------------------|--------------------|------------------------|---------------------------------------------------|
| Sleep         | 00                     | X                  | XXX                    | All circuit are off                               |
| CDMA idle(Rx) | 01<br>or 11            | 0                  | 100                    | CDMA Mode                                         |
| GPS idle(Rx)  | 01<br>or 11            | 1                  | 111                    | CDMA Mode                                         |
| CDMA Sot      | 10                     | 0                  | 100                    | All circuit are off except the<br>VCO, VCO buffer |
| GPS Slot      | 10                     | 1                  | 111                    | Not used                                          |

## CONTROL REGISTERS

S1M8662A has various registers which can be programmed by the SPI bus. These registers have their own function which are described below.

**Table 3. S1M8660A Control Registers**

| Register name | Address | R/W | Default vale | Description                                                                                  |
|---------------|---------|-----|--------------|----------------------------------------------------------------------------------------------|
| RESET         | 0x00    | W   | -            | Reset.<br>Reset S1M8662A and all the register values are returned to their default value.    |
| SPI_ID        | 0x01    | R   | 0x1F         | SPI_ID.<br>Each slave device has its own, independent code; S1M8662A code is 1E.             |
| BLOCK_CTL     | 0x03    | R/W | 0x8          | BLOCK_CTL<br>Decides on the S1M8662A operation mode. LO division ratio. Controls VCO output. |
| FILTER_SEL.   | 0x05    | R/W | 0x1C.        | FILTER_SEL.<br>Lowpass filter selection                                                      |
| VCO_CTL       | 0x06    | R/W | 0x0B         | VCO_CTL.<br>Controls the VCO operation and VCO output.                                       |

W : MODEM is recorded in the S1M8662A register R : When S1M8662A sends data to the modem

**Table 4. Description of Control Registers**

| Address | Name   | Type | Bits  | Description                                                                                                                                                                                                                                                                        |
|---------|--------|------|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 00(h)   | RESET  | W    | -     | When the master uses this register, the S1M8662A returns all the programmed register values to their initial value.                                                                                                                                                                |
| 01(h)   | SPI_ID | R    | [5:0] | This read-only register is used to confirm the type of slave connected to the master. It is set to 1Eh and all S1M8662A has the same value. This is the ID absolutely required to differentiate the controller from the data, when there are many slaves connected to the SPI bus. |

Table 4. Description Of Control Registers (Continued)

| Address | Name      | Type | Bits  | Description                                                                                                                                  |
|---------|-----------|------|-------|----------------------------------------------------------------------------------------------------------------------------------------------|
| 03(h)   | Block_CTL | R/W  | [7]   | Identifies the S1M8662A<br>Default = 1                                                                                                       |
|         |           |      | [6]   | Default = 0, Reserved Registers                                                                                                              |
|         |           |      | [5:4] | IF LO Divider, Default = 00<br>00 : 2, 01 : 3<br>10 : 4, 11 : 6                                                                              |
|         |           |      | [3]   | Default = 1, Reserved Registers                                                                                                              |
|         |           |      | [2]   | RXVCO_OUT2. Default = 1<br>1 : Singled Ended Output (RXVCO_OUT1 Active,<br>RXVCO_OUT2 Off)<br>0 : Differential Output (RXVCO_OUT1, 2 Active) |
|         |           |      | [1:0] | Mode. Default = 00<br>00 : Sleep, 01 : Receive<br>10 : Rx Slot, 11 : Receive                                                                 |
| 05(h)   | FILT_SEL  | R/W  | [7:2] | Default = 0001 11<br>Reserved Registers                                                                                                      |
|         |           |      | [1:0] | FILT_SEL Default = 00<br>00 : CDMA LPF<br>10 : GPS LPF                                                                                       |
| 06(h)   | VCO       | R/W  | [7]   | GPS_SEL Default = 0<br>0 : GPS Mode Disabled<br>1 : GPS Mode abled                                                                           |
|         |           |      | [6:3] | Default = 0001<br>Reserved Registers                                                                                                         |
|         |           |      | [2]   | CCO_CTL Default = 0<br>0 : RX_VCO Low Drive<br>1 : RX_VCO Low Max                                                                            |
|         |           |      | [1]   | Default = 11.<br>Reserved Registers                                                                                                          |
|         |           |      |       |                                                                                                                                              |

## CHARACTERISTIC GRAPH

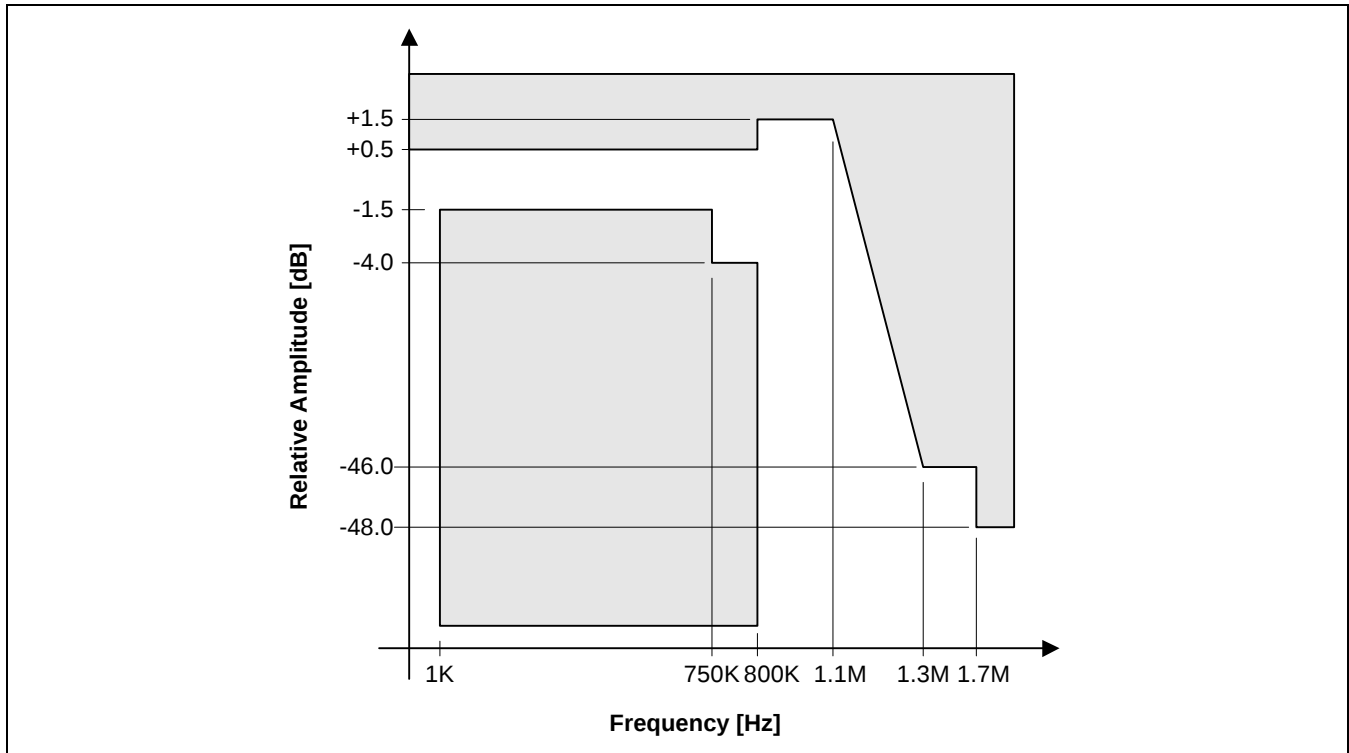


Figure 7. GPS Rx Low Pass Filter Mask

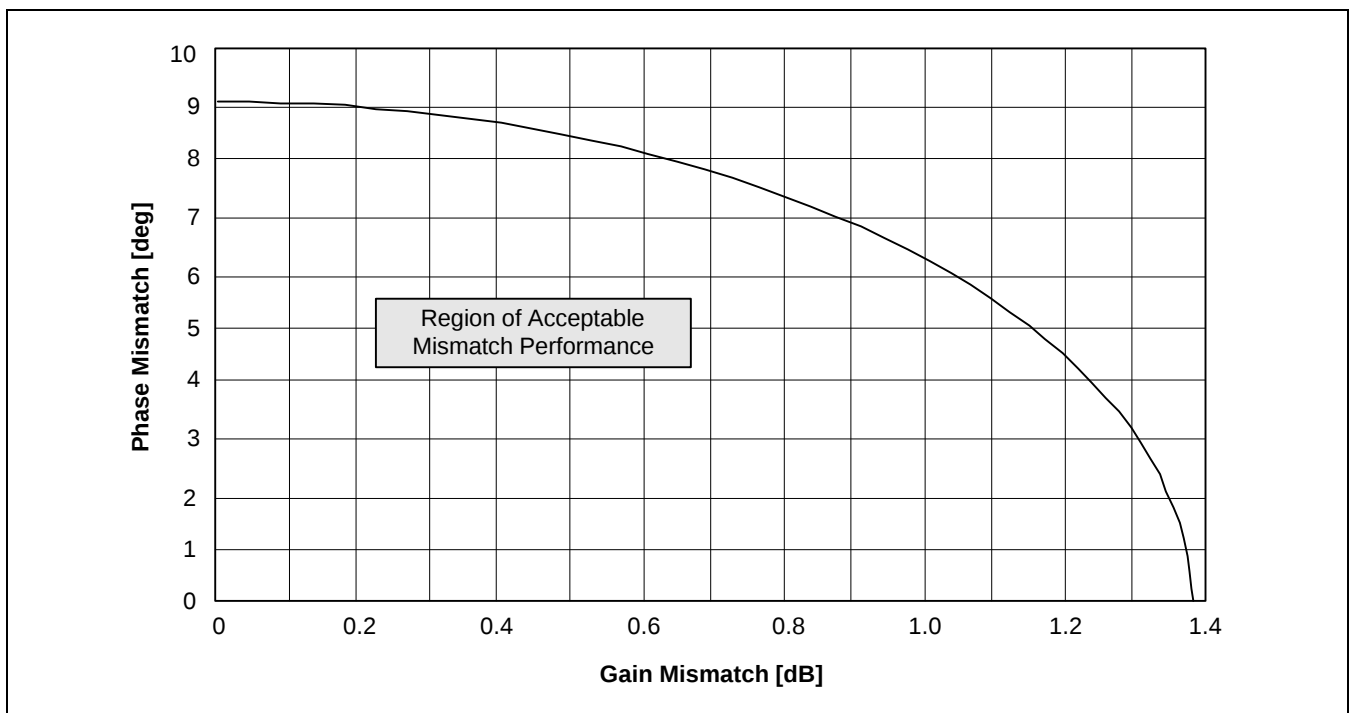


Figure 8. GPS Rx Gain/Phase Mismatch Specification

## CHARACTERISTIC GRAPH (Continued)

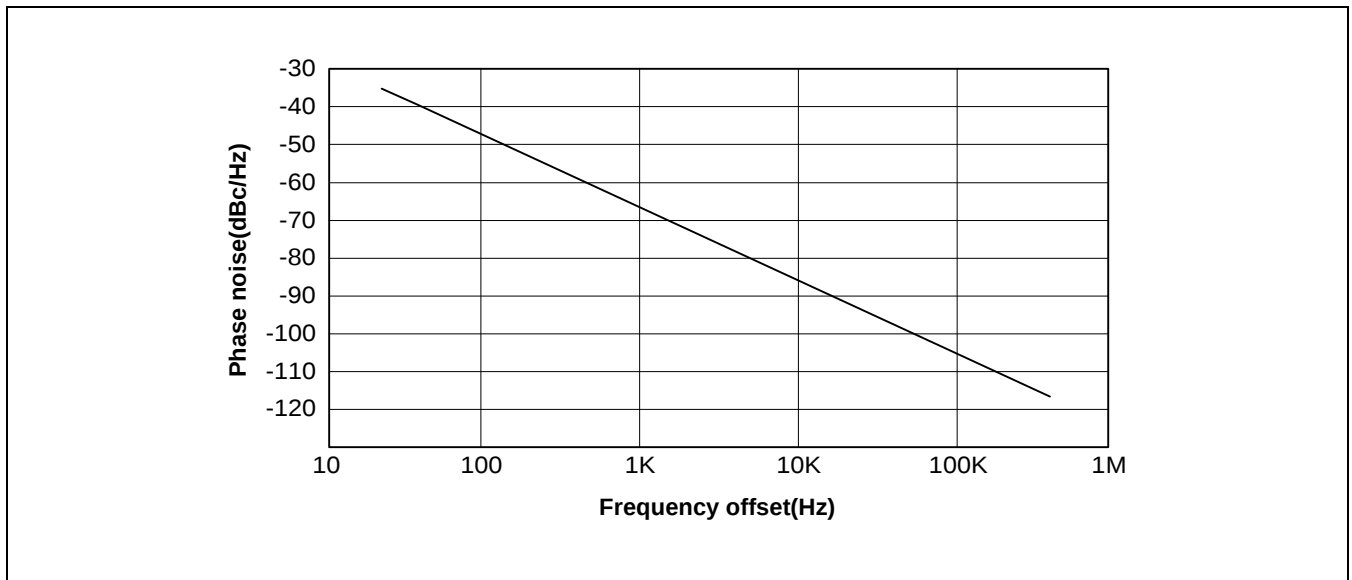


Figure 9. S1M8662A IF VCO Open Loop Phase Noise

CHARACTERISTIC GRAPH (Continued)

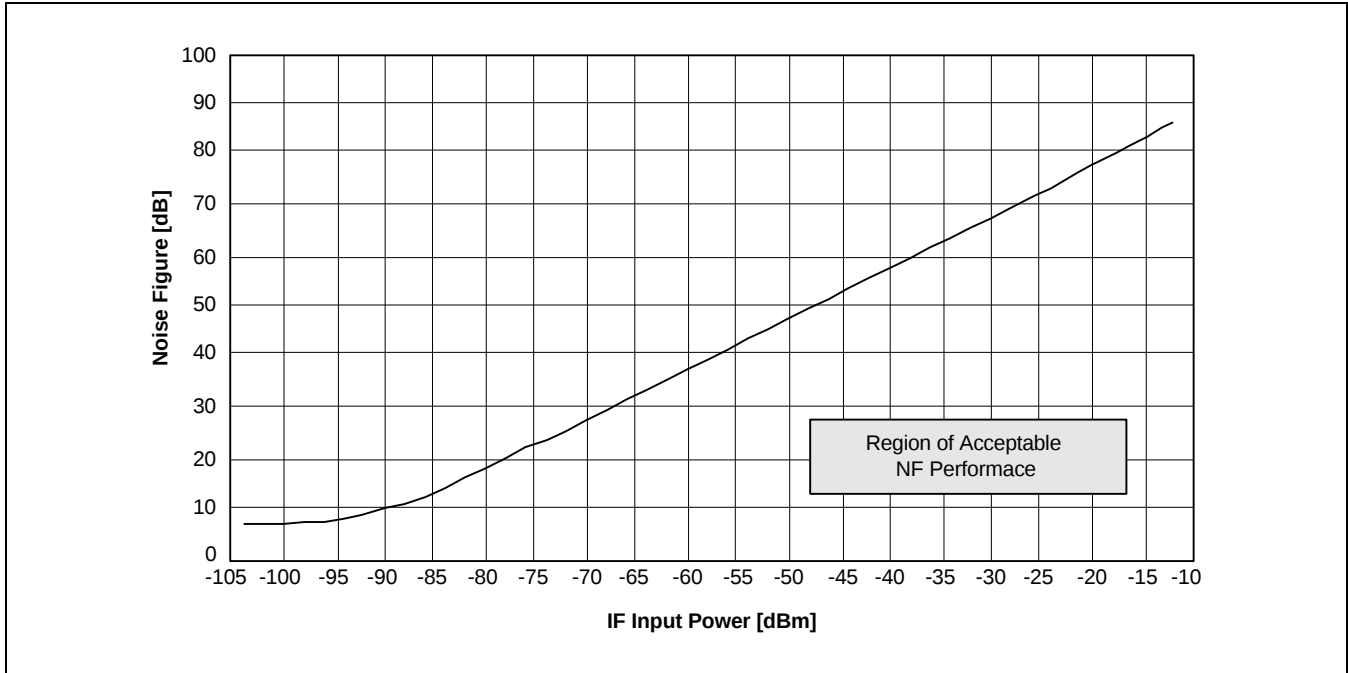


Figure 10. GPS Rx Mode Noise Figure Specification

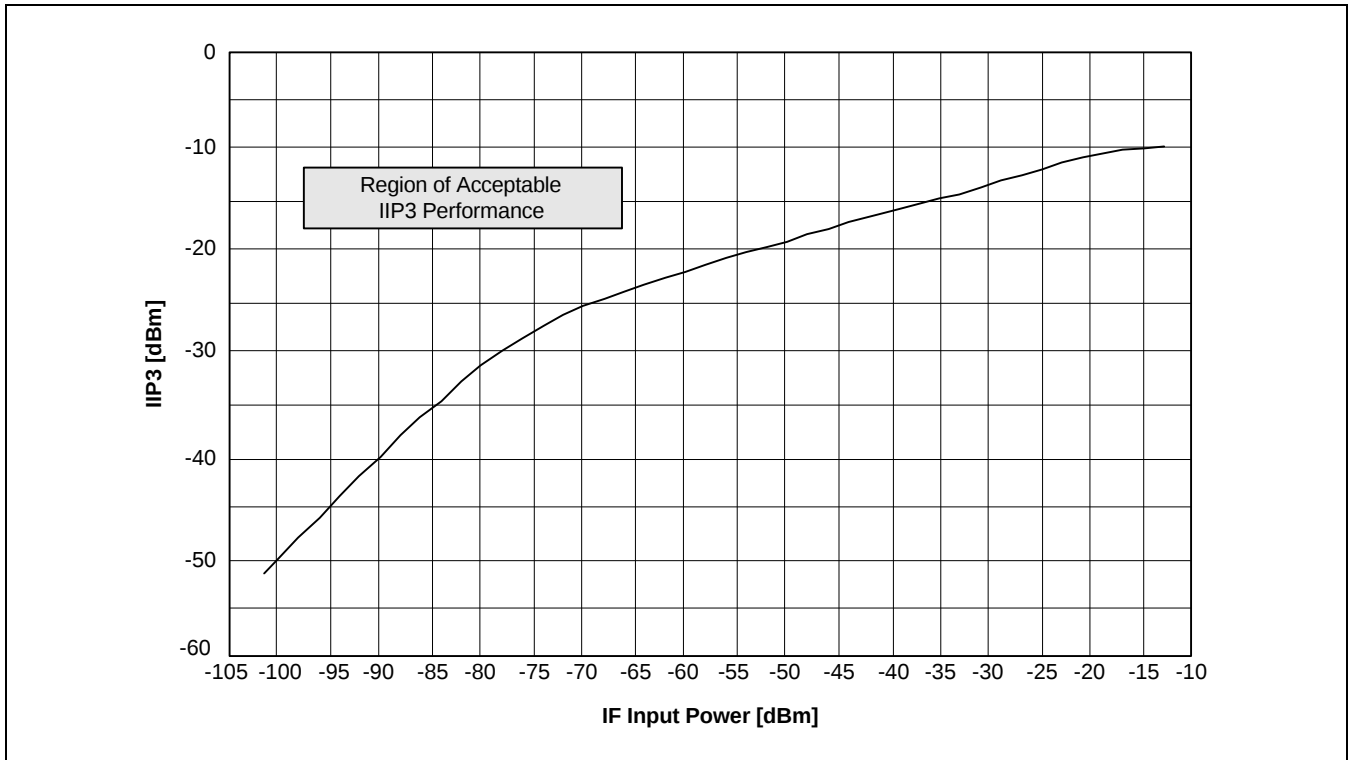
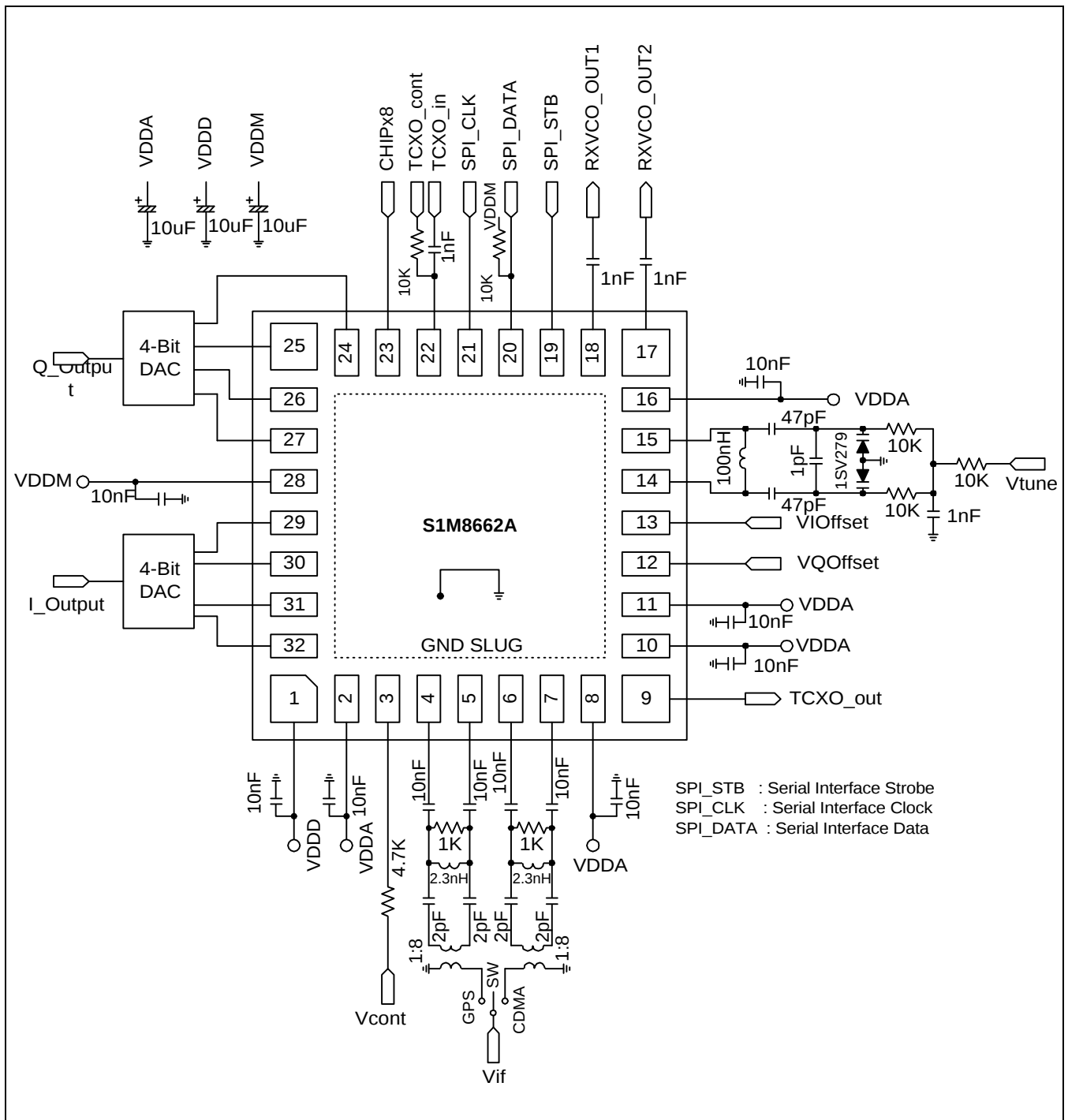


Figure 11. GPS Rx Mode IIP3 Specification

## TEST CIRCUIT



### Figure 12. Test Circuit

## PACKAGE DIMENSION

## 32BCC+ Package Outline

