SPECIFICATIONS AND FEATURES

DATASHEET

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UFirebirdII-UC6580

Dual-frequency GNSS Positioning Chip

Revision History

Version	Revision History	Date
R1.0	First Release	Sep.,2023
R1.1	Update the working voltage in technical specifications Update the IO power domain description Update Table 7-3	Oct., 2023

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Foreword

This datasheet provides information on the hardware features and performance specifications of UC6580 positioning chip.

Target Readers

This datasheet applies to technicians who have knowledge in the GNSS field but not to general readers.

Contents

1 Product Introduction

1.1 Overview

UC6580 is a dual-frequency multi-constellation positioning SoC developed by Unicore Communications, with sub-meter level accuracy, supporting BDS-3 signals. It adopts 22 nm process, low-power design, compact size, RF-baseband integrated technology, and supports multi-path mitigation, anti-jamming and high precision GNSS joint positioning, which performs well in the power and size sensitive scenarios.

UC6580 is suitable for global applications. It has 96 tracking channels, supports GPS, GLONASS, BDS, Galileo, NAVIC and QZSS multi-constellation joint positioning, as well as SBAS signal reception processing, providing fast and accurate positioning experience with high performance.

UC6580 supports L1 + L5/L2 dual-frequency single point positioning and multi-system raw data output. The former is suitable for wearables, handheld devices and walking navigation, significantly improving users' experience compared with single-frequency solution especially in urban multi-path environment, while the latter is suitable for vehicle navigation, robotic and UAV applications.

UC6580 has two models including automotive grade and industrial grade (see Table 1-1).

Table 1-1 UC6580 models

Model	Grade	Package
UC6580A	Automotive	QFN40
UC6580I	Industrial	QFN40

1.2 Product Features

- 22 nm dual-frequency multi-constellation GNSS SoC, with low power consumption and compact size
- Concurrent acquisition and tracking of dual frequencies from multiple constellations, including BDS-3 signals; supports:
  - BDS B1I/B1C* + B2a or B1I/B1C* + B2I
  - GPS L1 + L5 or L1 + L2
  - Galileo E1 + E5a or E1 + E5b
  - GLONASS G1 or G1+G2
  - QZSS L1 + L5 or L1 + L2
  - SBAS L1
  - NAVIC L5*
- Real-time wideband and narrowband anti-jamming technology: detection and removal of wideband and narrowband jamming of no less than -75 dBm
- Supports L1 + L5/L2 dual-frequency single point positioning, with excellent multi-path mitigation algorithm
- Supports L1 + L5/L2 dual-frequency multi-constellation raw data output, provides centimeter level RTK positioning and sub-meter level RTD positioning
- RF and baseband design with ultra-high sensitivity: acquisition sensitivity better than -148 dBm, tracking sensitivity better than -165 dBm
- Supports AGNSS
- Supports secure boot
- Automotive grade and industrial grade with QFN40 package (See the section 10.3 Ordering Information for more details)
- Conforms to the requirement of AEC-Q100 Grade2 (UC6580A)

* Supported by specific firmware.

1.3 Technical Specifications

Table 1-2 Technical Specifications

Basic Information			
Channels	96 channels		
Update Rate	10 Hz (max.)		
Data Format	NMEA-0183, Unicore, RTCM 3.x		
Frequencies		Mode 1	Mode 2*
	BDS	B1I/B1C* + B2a	B1I/B1C* + B2I
	GPS	L1 + L5	L1 + L2
	Galileo	E1 + E5a	E1 + E5b
	GLONASS	G1	G1 + G2
	QZSS	L1 + L5	L1 + L2
	NAVIC	L5*	-
	SBAS	L1	L1
Observation Accuracy			
Horizontal Accuracy (RMS)	Single point positioning: 1.5 m		
	RTK[1]: 1 cm + 1ppm		
Vertical Accuracy (RMS)	Single point positioning: 2.5 m		
	RTK[1]: 2 cm + 1ppm		
Time Accuracy (RMS)	5 ns, peak-to-peak value 30 ns (24h)		
Velocity Accuracy[2]	0.02 m/s		
TTFF[3]			
Cold Start	26s		
Hot Start	2 s		
Reacquisition	1 s		
Sensitivity[4,5]	GNSS		
Cold Start	-148 dBm		
Hot Start	-156 dBm		
Tracking	-162 dBm		

* Supported by specific firmware.

1 RTK accuracy depends on the customer's algorithm capability, and the reference data here is given according to Unicore self-developed algorithms.

2 Uniform linear motion of -33 mps using a simulator.

3 Satellite signal strength @ -130 dbm.

4 To get the sensitivity index, CN0 needs to achieve 41 dB (The performance might be updated).

5 Connect to a matched external LNA to ensure superior performance.

Reacquisition	-159 dBm	
Power Consumption[6] (@25°C)		
DCDC Mode	Acquisition: 40 mA@3 V	Tracking : 40 mA@3 V
Backup Mode	5 μA @ 3 V	
Working Voltage		
Main Power Supply	2.7 V ~ 3.6 V	
IO Power Supply	2.7 V ~ 3.6 V	
Backup Power Supply	1.7 V ~3.6 V	
Communication Interfaces		
UART × 2		
I^2C × 2		
SPI × 2		
Reliability Test and Certificates		
Reliability	Conforms to JESD47 standard (UC6580I) Conforms to ACE-Q100 standard (UC6580A)	
Certificates	Conforms to RoHS and REACH requirements	

[6] Depends on the firmware version.

2 Pin Definition

2.1 Pin Assignment

UC6580A and UC6580I have the same pins, and Figure 2-1 gives the diagram of UC6580A as an example.

QFN40 TOP VIEW (Marking Side)

		30	29	28	27	26	25	24	23	22	21		
		PIO3	PIO5	PIO1	PIO2	PIO4	PIO0	LDO_C	V_CORE	DCDC_OUT	DCDC_IN		
31	SCL											NC	20
32	SDA											TX	19
33	D_SEL											RX	18
34	BOOT_MODE											RESETN	17
35	PPS											TMS	16
36	PIO15											TCK	15
37	PIO16											PIO13	14
38	L5_IN											PIO14	13
39	NC											RTC_I	12
40	L1_IN											RTC_O	11
		NC	LDO_X	TCXO_IN	NC	LDO_EX	V_BACK	VDD_IO	V_DET	VDD_ANT	LDO_RET		
PIN Number		1	2	3	4	5	6	7	8	9	10		

Figure 2-1 UC6580 Pin Diagram

2.2 Pin Description

Table 2-1 Description of Power Supply Pin

Name	Pin	Type	Description
DCDC_IN	21	Power	DC/DC power input
DCDC_OUT	22	Power	DC/DC power output
V_CORE	23	Power	Core power input
V_BACK	6	Power	Backup power input
VDD_IO	7	Power	IO/TCXO power input
LDO_C	24	Power	Core LDO voltage output
LDO_X	2	Power	TCXO LDO voltage output
LDO_EX	5	Power	Used by the chip itself, and cannot supply power to other circuits
NC	20	Power	Keep NC
V_DET[7]	8	Power	Antenna detection power input
VDD_ANT	9	Power	Antenna power output
LDO_RET	10	Power	Backup power output
GND			Ground

Table 2-2 Analog Pin Description

Name	Pin	Type	Description
L1_IN	40	RF	L1 RF input
L5_IN	38	RF	L5 or L2 RF input
TCXO_IN	3	Clock	26 MHz TCXO input
RTC_I	12	Clock	32.768 kHz crystal or digital waveform input
RTC_O	11	Clock	32.768 kHz clock output
NC	4	-	Keep NC
NC	39	-	Keep NC
NC	1	RF	Keep NC

Table 2-3 PIO Pin Description

Name	Pin	Type	IO Reset	Description
PIO0	25	IO	I/Pull-up	GPIO0
PIO1	28	IO	I/Pull-up	GPIO1
PIO2	27	IO	I/Pull-up	GPIO2
PIO3	30	IO	I/Pull-up	GPIO3
PIO4	26	IO	I/Pull-up	GPIO4

[7] Not supported currently.

Name	Pin	Type	IO Reset	Description
PIO5	29	IO	I/Pull-up	GPIO5
TX	19	IO	I/Pull-up	GPIO6
RX	18	IO	I/Pull-up	GPIO7
SCL	31	IO	I/Pull-up	GPIO8
SDA	32	IO	I/Pull-up	GPIO9
D_SEL	33	IO	I/Pull-up	GPIO10
PPS	35	IO	I/Pull-up	GPIO11
BOOT_MODE	34	IO	I/Pull-up	GPIO12
PIO13	14	IO	I/Pull-up	GPIO13
PIO14	13	IO	I/Pull-up	GPIO14
PIO15	36	IO	I/Pull-up	GPIO15
PIO16	37	IO	I/Pull-up	GPIO16
TMS	16	IO	I/Pull-up	GPIO17
TCK	15	IO	I/Pull-up	GPIO18
RESETN	17	IO	I/Pull-up	-

3 Chip Structure

3.1 Block Diagram

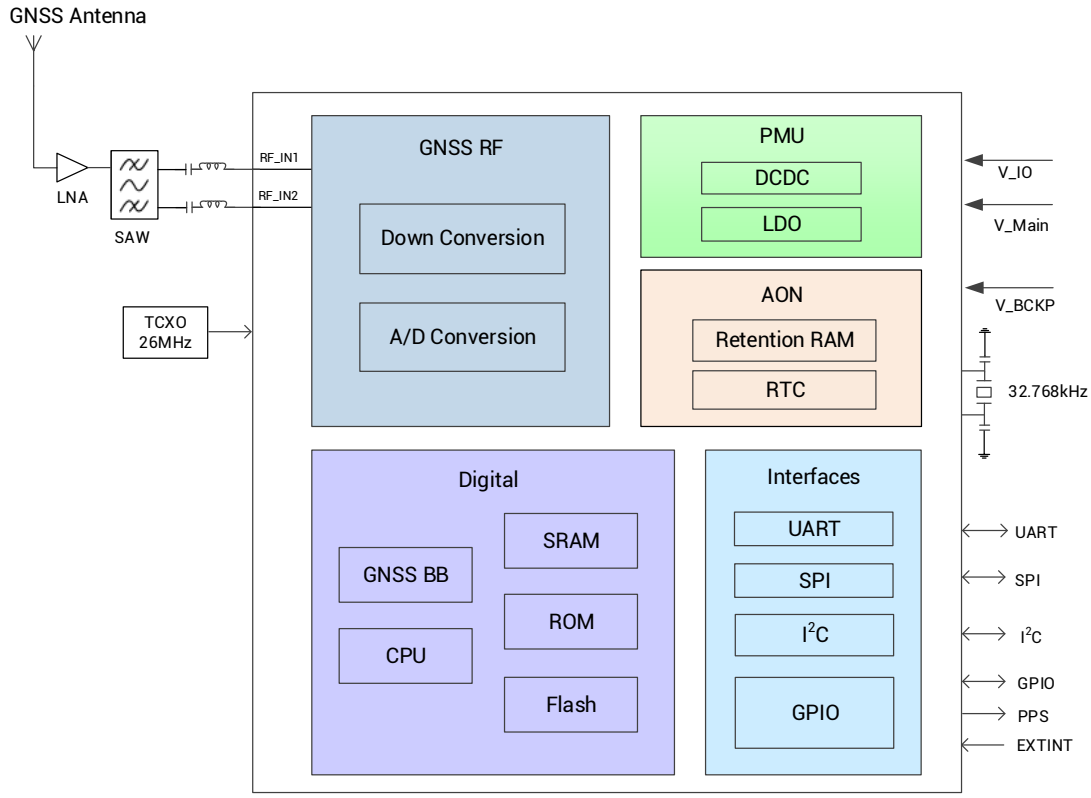


Figure 3-1 UC6580 Block Diagram

3.2 Power Management Unit (PMU)

The Power Management Unit (PMU) provides four power domains that are internally generated by LDOs and supervised by several voltage monitors:

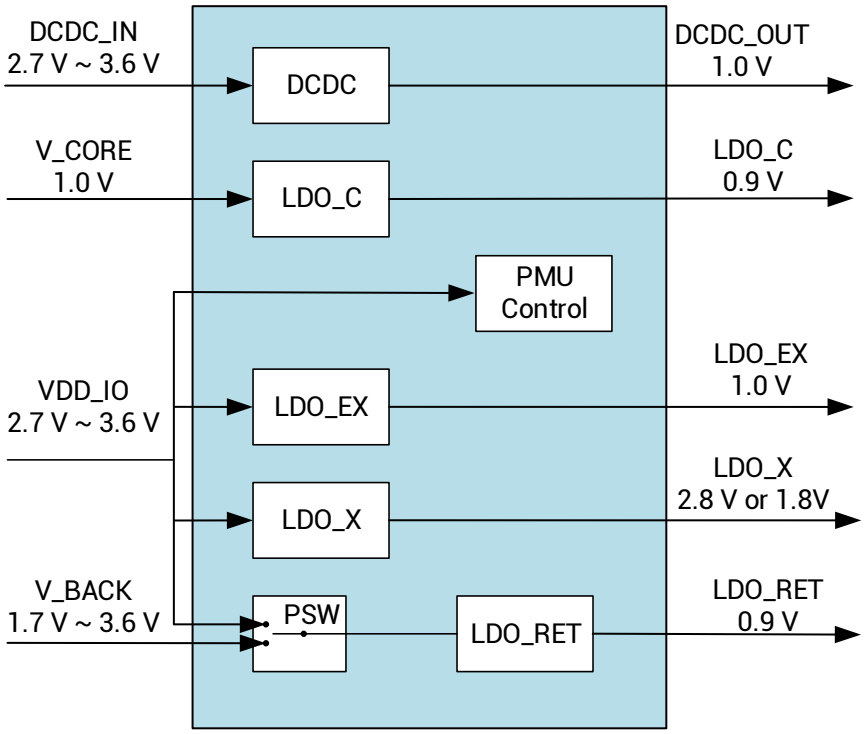


Figure 3-2 Power Management Unit (PMU)

- **Core**

Core domain is the main power domain for the RF and digital part inside the chip. The subsequent LDO_C converts the V_CORE input to respective voltages, which must be connected with a decoupling capacitor through the LDO_C pin. LDO_C drives the digital logic parts.

- **IO**

IO power domain is powered by VDD_IO, including the chip IO devices, on-chip Flash, etc. The voltage supply of VDD_IO is 2.7 V ~ 3.6 V. Except IO devices, other PMU devices are powered by a dedicated LDO_EX. LDO_EX must be connected with a decoupling capacitor through LDO_EX pin.

- **Backup**

Backup domain runs the RTC section and Retention RAM. This domain uses VDD_IO and V_BACK as the voltage sources. When the range of VDD_IO is normal, it uses VDD_IO, otherwise uses V_BACK. The allowed range of V_BACK is 1.7 V ~ 3.6 V. Therefore, an ordinary lithium battery or other battery can be directly connected to this pin. If you do not need the RTC and backup function, you must connect the V_BACK pin to VDD_IO.

- **TCXO**

The clock domain supplies power to TCXO. This domain has a dedicated LDO called LDO_X, which is also powered by VDD_IO. If TCXO is powered by LDO_X, LDO_X should be connected to the power pin of TCXO and be decoupled by a capacitor. You can also choose an external power source other than LDO_X to power TCXO.

Based on the above division of power domains and hardware design, UC6580 has three modes of power consumption:

- Running mode: Every power source of the chip is normal, CPU runs normally, and the power supply of each domain is set by the software. All events, including external interruption, communication request, timing, etc., can be processed normally.
- V_BACK mode: The IO and main power supply of the chip is cut off from the outside, and there is only V_BACK power supply left. At this time, the power consumption of the chip drops to a very low level, and the specific functions and power consumption depend on the mode set by the software. It can wake up as soon as it is powered on.
- Power off mode: All power supplies are cut off from the outside, and the chip does not work at all.

3.3 Clock

The chip requires an external 26 MHz clock, which is generated by TCXO, to provide reference frequency for RF and baseband PLL. In order to ensure the stable operation of the PLL when the chip is booted, the 26 MHz clock should work stably within10 ms after the main and IO domains are powered.

The chip supports RTC crystal input. RTC crystal is usually driven by an on-chip 32.768 kHz oscillator, which connects to an external 32.768 kHz crystal. The chip also supports external RTC clock input. The input signal amplitude should be 0.9 V to 1.98 V, and the input signal frequency should be 32.768 kHz. The RTC clock frequency offset must be less than 20 ppm.

Table 3-1 Clock

	Frequency Source	Frequency	Remark
System Clock	TCXO	26 MHz	Work stably within10 ms after the main and IO domains are powered
RTC Clock	On-chip oscillator	32.768 kHz	Connect an external 32.768 kHz crystal
	External digital waveform generator	32.768 kHz	Input signal amplitude should be 0.9 V to 1.98 V

If the main power supply and IO power supply fail and a backup battery is connected to V_BACK, the baseband, RF and CPU do not work, while RTC keeps running to provide time reference for the receiver. This operating mode is called RTC time keeping mode. Under this mode, the relevant data are saved in Retention RAM for GNSS hot start.

RTC time keeping mode is a prerequisite for GNSS hot start. Under this mode, RTC provides time information and Retention RAM provides ephemeris and almanac information. If you do not need GNSS hot start function, connect RTC_O to ground. In the AGNSS-based system, if time and ephemeris are provided through network as assistance, RTC is not necessary.

Table 3-2 RTC Timing Keeping Mode

Mode	Power Supply	Working Parts				
		BB	RF	CPU	RTC	Retention RAM
RTC time keeping	V_BACK				●	●

3.4 System Reset

According to the power structure of UC6580, there are two reset domains: Core domain and Backup domain.

Core domain can be reset by three methods:

- RESETN is the reset pin of the chip. When the voltage level at RESETN is low, the reset signal will be sent to the Core domain. The duration of RESETN low level should be more than 10 us.
- The chip's software reset, which is controlled by the firmware.
- Watchdog RESET.

If any of the above reset sources issues a reset signal, the Core domain is reset.

Backup domain can be reset by two methods:

- When the voltage of V_BACK is lower than 1.2 V, it will trigger the reset.
- The software system sends the RTC RESET signal, which is controlled by the firmware and only resets the RTC counter.

4 RF Subsystem

The RF subsystem of UC6580 adopts dual-frequency dual-channel architecture. The frequency of the input signal ranges from 1166MHz to 1620MHz. The received GNSS signals are amplified by a single-ended Low Noise Amplifier (LNA), and then fed to a RF gain block to be further amplified, thus reducing the noise figure requirements for the mixer. The RF gain block also provides a single-ended to differential conversion. After completing the orthogonal down-conversion, multi-GNSS signals are divided into two channels. Afterwards, the I and Q signals of both channels are low-pass filtered and amplified by a separate Programmable Gain Amplifier (PGA), after which both I and Q signals are sent to the 6-bit high-speed ADC section for data conversion.

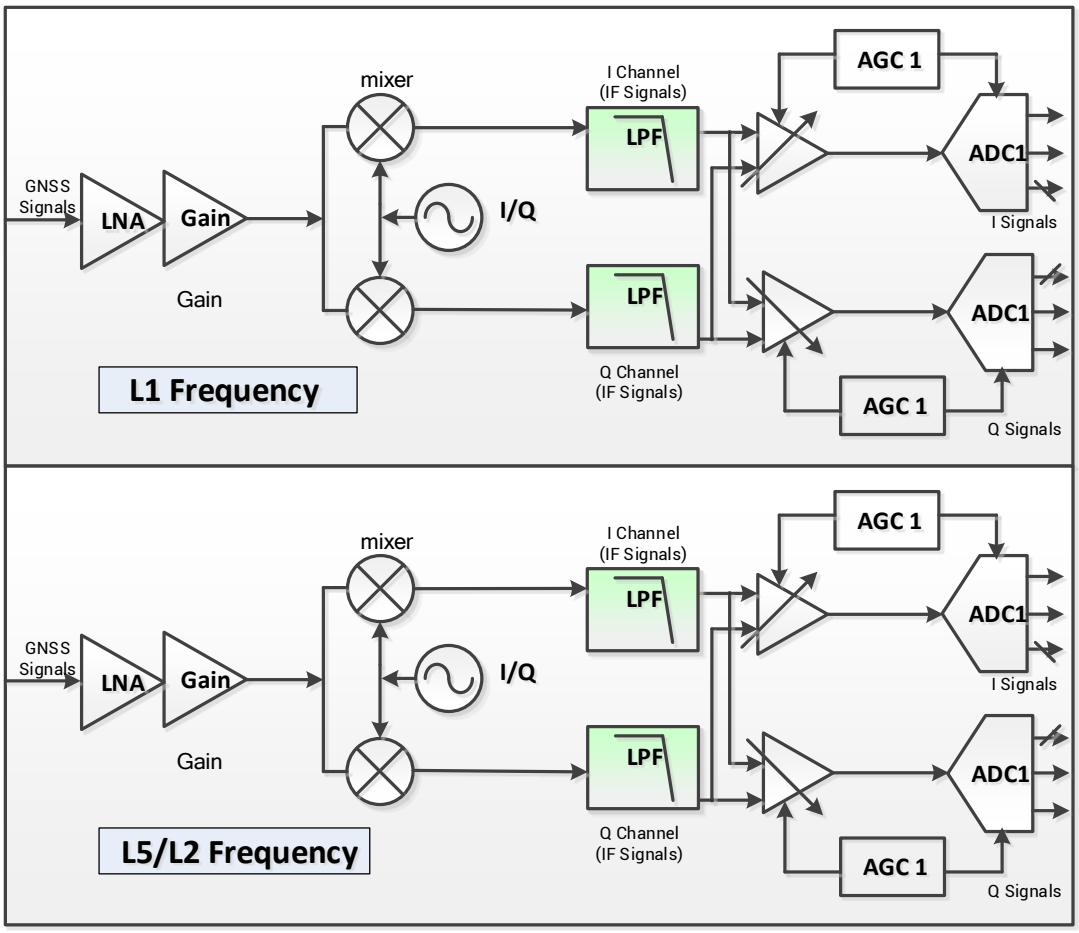


Figure 4-1 RF Subsystem

The RF subsystem of UC6580 supports any mode below:

- Dual-frequency L1+L5
- Dual-frequency L1+L2
- L1 single-frequency multi-constellation mode.

4.1 LNA

The low noise amplifier (LNA) makes use of a single stage configuration and requires external matching to function satisfactorily. For improved performance, an external LNA should be added, of which the gain range is recommended to be within 17dB~50dB. In an environment with complex interference, it is necessary to use an external SAW filter to suppress out-of-band interference.

4.2 Gain Block

A single stage differential amplifier follows the LNA providing further amplification and conversion from single-ended signals to differential signals.

4.3 Mixer

UC6580 uses the active I/Q mixer to first convert the multi-GNSS signals to an intermediate frequency signals. At this stage, the signals are split into two IF channels after down-conversion.

4.4 IF Filter

UC6580 integrates an I/Q low-pass filter to remove the out-of-band noise after RF down-conversion, which improves the noise performance of the RF system.

4.5 AGC

UC6580 supports Automatic Gain Control (AGC), which reduces the convergence time and computing cost. AGC controls the gain configuration of each module in the radio frequency data link according to the signal energy required by the RF system.

4.6 PGA and ADC

UC6580 integrates Programmable Gain Amplifier (PGA) and high-speed Analog Digital Convertor (ADC). The gain value of PGA is configured by AGC to ensure that the signal energy output by ADC remains unchanged when the RF input signal energy changes within a certain range, thereby ensuring that the output of the high-speed ADC does not saturate. The high-speed ADC supports the output of I/Q complex sampling signals.

5 Baseband Subsystem

UC6580 provides multiple interfaces for data communication or access to external devices, such as UART, SPI, I²C, GPIO, etc.

5.1 Interfaces

5.1.1 UART

UC6580 makes use of two UART interfaces: UART1 and UART2. Both of them can be used for communication with a host.

UART1By default, PIO6/PIO7 corresponds to UART1, which serves as the main UART in standard firmware version. The communication interface of UC6580 can be mapped to different PIO interfaces via BOOT_MODE. PIO6/PIO7 can also be used as SPI, and in this case, there is no UART1 function. See the description in section 6.2 for the use of BOOT_MODE and the corresponding communication interface mapping.

UART2 can usePIO15/PIO16. It is mainly used for transmitting or debugging auxiliary information.

5.1.2 SPI Slave Interface

UC6580 uses SPI slave interface as an optional way to communicate with the host to transfer data. At the same time, it supports loading firmware via the SPI slave interface. The maximum transmission rate using SPI slave is 8 Mbps, and the maximum SPI clock frequency is 8 MHz. When the SPI slave loads the firmware, the maximum transmission rate is 4 Mbps.

The SPI slave interface shares PIO6/PIO7 and PIO8/PIO9 with UART1 and I²C respectively. Users can select the communication interface via D_SEL and BOOT_MODE. If PIO6/PIO7/PIO8/PIO9 is used as SPI slave interface, there are no UART1 and I²C1 functions; if PIO6/PIO7 and PIO8/PIO9 are used as UART1 and I²C1, there is no SPI slave interface.

When the SPI slave interface is used for host communication, PIO14 should be used as the SRDY (Slave Ready) signal to indicate whether the SPI slave is ready.

5.1.3 SPI Master Interface

UC6580 provides SPI master interface by configuring PIO0/PIO1/PIO3/PIO4, which can be used to communicate with or control other SPI slave devices. The maximum transmission rate of the SPI master interface is 16 Mbps, and the maximum SPI clock frequency is 16 MHz.

The SPI master interface is disabled by default.

5.1.4 I^2C

UC6580 provides two I^2C interfaces (I^2C1 and I^2C2) to communicate with the host or sensor, of which the I^2C1 interface works in slave mode for firmware loading and communicating with the host, and I^2C2 works in master mode to connect to the external sensor. The I^2C interfaces are compatible with the I^2C protocol, supporting the transmission rates of 100 Kbps, 400 Kbps, and 3.4 Mbps.

By default, the I^2C1 interface uses PIO8/PIO9, and the BOOT_MODE pin should be in pull-up or open-circuit state when booting. For more information, please refer to the description in section 5.2. I^2C2 can be mapped to PIO13/PIO14 through customized firmware.

5.1.5 Serial Flash Interface

Serial Flash interface is used to connect UC6580 with external SPI Flash. SPI Flash can be used for firmware storage and update.

The serial Flash interface uses PIO0/PIO1/PIO2/PIO3/PIO4/PIO5 only when the BOOT_MODE pin is in pull-up or open-circuit state when booting; otherwise, the serial Flash interface is invalid.

5.2 PIO Functions

The PIO module may be configured as GPIO or as the aforementioned communication interfaces. The following table describes all PIO functions.

Table 5-1 PIO Functions

PIO #	Default Function	I/O	Description	Alternate Function
0	GPIO	I/O	-	SPI master MISO SPI flash D0
1	GPIO	I/O	-	SPI master MOSI SPI flash D1

PIO #	Default Function	I/O	Description	Alternate Function
2	GPIO	I/O	-	PWM0 UART2 RXD SPI flash WP
3	GPIO	I/O	-	PWM1 UAR1 TXD SPI flash HOLD
4	GPIO	I/O	-	SPI master CLK SPI flash CLK
5	GPIO	I/O	-	SPI master CSN SPI flash CSN
6	GPIO	I/O	Controlled by BOOT_MODE when booting: UART1 TXD (if BOOT_MODE is high when booting) SPI slave MISO (if BOOT_MODE is low when booting)	UART1 TXD SPI slave MISO
7	GPIO	I/O	Controlled by BOOT_MODE when booting: UART1_RXD (if BOOT_MODE is high when booting) SPI slave MOSI (if BOOT_MODE is low when booting)	UART1 RXD SPI slave MOSI
8	GPIO	I/O	Controlled by BOOT_MODE when booting: I^2C1 SCL (if BOOT_MODE is high when booting) SPI slave CLK (if BOOT_MODE is low when booting)	I^2C1 SCL SPI slave CLK
9	GPIO	I/O	Controlled by BOOT_MODE when booting: I^2C1 SDA (if BOOT_MODE is high when booting) SPI slave CSN (if BOOT_MODE is low when booting)	I^2C1 SDA SPI slave CSN

PIO #	Default Function	I/O	Description	Alternate Function
10	GPIO	I/O	Communication interface selection pin. Select from PIO6 to PIO9. Only valid when booting. This pin is pulled up if it is not connected.	PPS D_SEL 32.768 kHz clock
11	GPIO	I/O	-	PPS EVENT UART1 RXD
12	GPIO	I/O	Bootstrap mode selection pin. Select firmware loading address, external/internal Flash or SPI interface. Only valid when booting. This pin is pulled up if it is not connected.	BOOT MODE PPS RF_READY UART1 TXD
13	GPIO	I/O	-	I^2C2 SCL ODO_DIR EVENT
14	GPIO	I/O	-	I^2C2_SDA ODO_CNT EVENT
15	GPIO	I/O	-	UART2 TXD LO1_DET
16	GPIO	I/O	-	UART2 RXD BLK LO2_DET
17	TMS	I/O	Debug interface	ODO_DIR GPIO
18	TCK	I/O	Debug interface	ODO_CNT GPIO

☞ If you want to change the I/O alternate function, please contact the UNICORECOMM FAE.

5.3 Time Management Unit

The Time Management Unit (TMU) manages all clock sources in the baseband, using more accurate clocks to calibrate less accurate clocks.

5.4 Watchdog

UC6580 contains two watchdog timers which prevent the system-lockup caused by the software deadlock. During normal operation, the firmware resets the watchdog's internal counter at regular intervals before the timer overflow occurs.

5.5 Timer Counter

The timer counter has an EVENT input and a PPS output. EVENT can be input via PIO11, PIO13 or PIO14, but only one EVENT can be input at a time. Event input is the external timestamp event relative to GPS time.

☞ EVENT function is disabled by default. Please contact Unicore FAE if necessary.

PPS can be output via PIO11. PPS outputs pulse sequence synchronized with GPS or UTC time grid, and the time interval can be configured over a wide range of frequency.

All input and output signals are synchronized with the internal clock frequency of the receiver, so that the inherent maximum quantization error of the input and output signals reaches ±10 ns.

6 System Configuration

6.1 Power Supply Scheme

UC6580 supports two power supply schemes, including internal DC-DC mode and LDO mode.

☞ If you do not use the hot start and backup function, connect the V_BACK to VDD_IO

6.1.1 DC-DC Mode

In this mode, the main power (V_Main) connects to the pin DCDC_IN, and the output of the DCDC module DCDC_Out provides the power to the rest circuits. At this time, the system is powered by the internal DC-DC:

- DCDC_IN and VDD_IO use the same power.
- V_BACK can use an independent power, or use the same power as DCDC_IN and VDD_IO.
- The system power supply is input by DCDC_IN, and DCDC_Out is connected to the V_CORE input pin.
- TCXO is powered by LDO_X. The voltage could be 1.8 V or 2.8 V.

6.1.2 LDO Mode

In this mode, the main power (V_Main) connects to DCDC_IN while DCDC_IN and DCDC_Out are short-circuited and the internal DC-DC is bypassed, so that the V_Main provides the power to the rest circuits directly. At this time:

- DCDC_IN and DCDC_OUT are short-circuited together.
- DCDC_IN and VDD_IO use the same power.
- V_BACK can use an independent power, or use the same power as DCDC_IN and VDD_IO.
- The system power supply is input by VDD_IO and output to V_CORE through LDO_EX.
- TCXO is powered by LDO_X. The voltage could be 1.8 V or 2.8 V.

For specific design scheme of the above modes, please refer to *UC6580 Hardware Reference Design*.

6.2 BOOT Mode

The boot mode of UC6580 is a standalone mode which is controlled by D_SEL (PIO 10) and Boot_Mode (PIO 12). According to the two PIO's status, the mode divides into three situations:

- Boots from UART1 (PIO6 and PIO7) and I²C1 (PIO8 and PIO9)
- Boots from UART1 (PIO11 and PIO12)
- Boots from SPI slave (PIO6 to PIO9).

See Table 6-1 to Table 6-5 for the details of the pin function configuration at boot and the boot mode description.

BOOT_MODE is valid only at power-on or before the RESETN signal is sent. After the RESETN signal is sent, the BOOT_MODE pin can be used as an ordinary PIO pin.

Table 6-1 Pin Function Configuration at Boot

D_SEL	BOOT_MODE	Boot Mode	Boot Time			After Boot	Remark
			PIO6，7	PIO8/9	PIO11/12		
1	X	Boots from UART1 and I²C1	UART1	I²C1	X	Outputs the positioning information through UART1 (PIO 6 and PIO7)	
0	1	Boots from UART1	X		UART1	Outputs the positioning information through SPI slave (PIO 6 to PIO9)	Boots from UART1 (PIO 11 and PIO12), no I²C1 boot
0	0	SPI slave	SPI slave		X	Outputs the positioning information through SPI slave (PIO 6 to PIO9)	

The boot steps are as follows:

1. CPU detects the firmware upgrade request from the interfaces.

Table 6-2 UART1 and I²C1 Boot Mode

If	Then
CPU detects a firmware upgrade request from UART1 within 20 ms after power-on or reset.	CPU starts to adapt the baud rate and upgrade the firmware. After the upgrade, run the firmware.
CPU detects a firmware upgrade request from I²C1 within 20 ms after power-on or reset.	CPU starts to adapt the I²C1 clock and upgrade the firmware. After the upgrade, run the firmware.
CPU does not detect a firmware upgrade request from UART1 or I²C1 within 20 ms after power-on or reset.	Do step 2

Table 6-3 UART1 Boot Mode

If	Then
CPU detects a firmware upgrade request from UART1 within 20 ms after power-on or reset.	CPU starts to adapt the baud rate and upgrade the firmware. After the upgrade, run the firmware.
CPU does not detect a firmware upgrade request from UART1 within 20 ms after power-on or reset.	Do step 2

Table 6-4 SPI Slave Boot Mode

If	Then
CPU detects a firmware upgrade request from SPI slave within 20 ms after power-on or reset.	CPU upgrades the firmware and runs it after the upgrade.
CPU does not detect a firmware upgrade request from SPI slave within 20 ms after power-on or reset.	Do step 2

2. CPU detects built-in flash and external flash in order.

Table 6-5 CPU Detects Flash

If	Then
CPU detects a firmware in the built-in flash.	CPU reads the firmware and runs it.
CPU does not detect the firmware in the built-in flash.	CPU tries to read the firmware in external flash and runs it.

7 Electrical Specifications

7.1 DC Electrical Specifications

7.1.1 Absolute Maximum Rating

Table 7-1 Absolute Maximum Rating

Symbol	Parameter	Min.	Max.	Unit
DCDC_IN	Input voltage of the internal DC/DC converter	-0.2	3.6	V
V_CORE	Supply voltage of baseband main core and RF	-0.2	1.05	V
DCDC_OUT	Output voltage of the internal DC/DC converter	-0.2	1.05	V
VDD_IO	Input voltage of I/O, LDO_X and flash	-0.2	3.6	V
V_BACK	Supply voltage of backup domain	-0.2	3.6	V
TCXO_IN	Input voltage on TCXO_IN	-0.2	2.9	V
RTC_I	Input voltage on RTC_I	-0.2	1.98	V
Vidig	Input voltage on PIO	-0.2	3.6	V
Prfin	RF input power on LNA_IN		+15	dBm
Ptot	Total power		360 (@room temperature)	mW
Tjun	Junction temperature	-40	+125	°C
Ts	Storage temperature	-50	+150	°C

☞ The ripple voltage of all the input voltages must be within 50 mV.

7.1.2 Recommended Working Conditions

Table 7-2 Recommended Working Conditions

Symbol	Parameter	Min.	Typical	Max.	Unit
DCDC_IN	Input voltage of internal DC/DC converter	2.7	3.3	3.6	V
V_CORE	Supply voltage of baseband main core and RF	0.9	1.0	1.05	V
VDD_IO	Input voltage of I/O, LDO_X and flash	2.7	3.3	3.6	V
V_BACK	Supply voltage of backup domain	1.7	3.3	3.6	V

7.2 Analog Electrical Specifications

Table 7-3 Analog Electrical Specifications 1

Symbol	Parameter	Min.	Typical	Max.	Unit
LDO_X	LDO_X output voltage (1.8 V TCXO)	1.75	1.8	1.95	V
	LDO_X output voltage (2.8 V/2.9 V TCXO)	2.75	2.8	2.95	V
LDO_RET	LDO_RET output voltage	0.6	0.9	0.95	V
LDO_C	LDO_C output voltage	0.85	0.9	0.95	V
LDO_EX	LDO_EX output voltage	0.95	1.0	1.05	V
V_DET[8]	Antenna detection input	2.7	3.3	3.6	V
VDD_ANT[9]	Antenna power output	2.7	3.3	3.6	V
RTC_I	32.768 kHz crystal or digital waveform input			1.98	V
RTC_O	32.768 kHz clock output			1.98	V
DCDC_OUT	Output voltage of the internal DC/DC converter	0.9	1.0	1.05	V
TCXO_IN_Vpp	TCXO input peak-to-peak voltage	0.5	0.6	1.98	Vpp

Table 7-4 Analog Electrical Specifications 2: RTC Specifications

Symbol	Parameter	Condition	Min.	Typical	Max.	Unit
RTC_Fxtal	RTC crystal oscillator resonate frequency			32768		Hz

[8] Not supported currently.

[9] The output voltage of VDD_ANT = V_DET- (antenna current) * (10 Ω).

Symbol	Parameter	Condition	Min.	Typical	Max.	Unit
RTC_T_start	RTC startup time		0.2	1	2	s
RTC_CL	RTC load capacitance	ESR = 80 kΩ		12.5		pF
RTC_Vil	RTC low level input voltage	Shared RTC oscillator input	0.0		0.2	V
RTC_Vih	RTC high level input voltage	Shared RTC oscillator input	0.9		1.98	V

7.3 RF Electrical Specifications

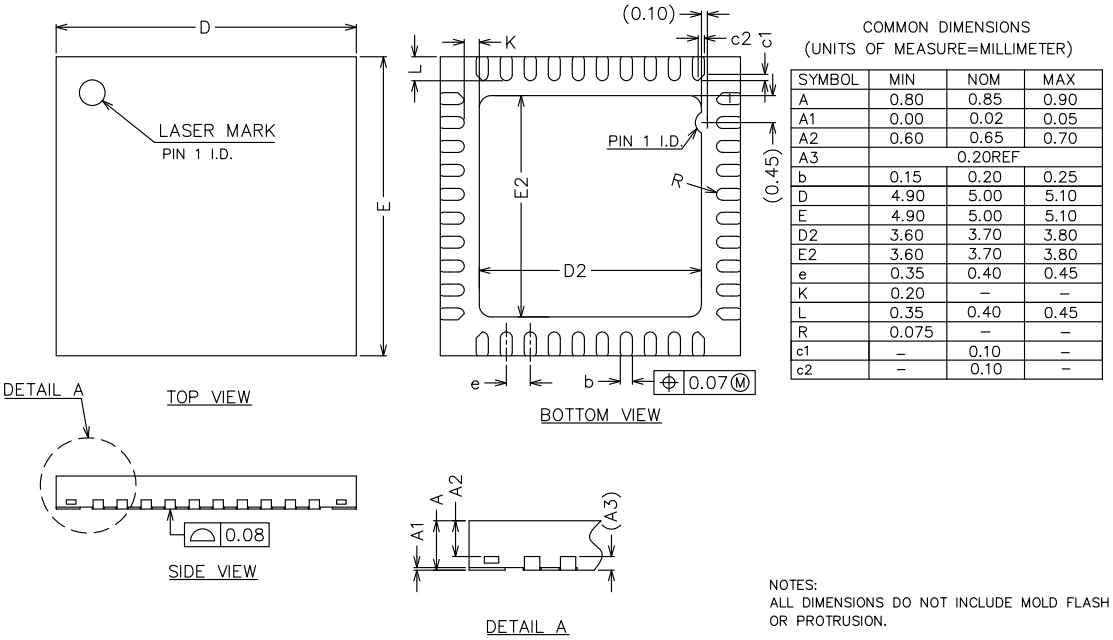
Table 7-5 RF Electrical Specifications

Symbol	Parameter	Condition	Min.	Typical	Max.	Unit
L1_IN	Receiver input frequency		1559.098	1561.098	1606	MHz
L5_IN	Receiver input frequency		1166.45	1176.45	1217.14	MHz
LNA_IN	LNA input impedance			50		Ω
LNA_S11	LNA input return loss	50Ω environment		-10		dB
NFtot	Receiver cascaded noise figure	50Ω environment		5		dB
Ext_Gain	External LNA gain	50Ω environment	15	17	60*	dB
TCXO_Freq	TCXO frequency	0.5ppm		26		MHz

* When the external LNA gain falls into this range, the system's CN0 fluctuates by 1dB.

8 Mechanical Dimensions

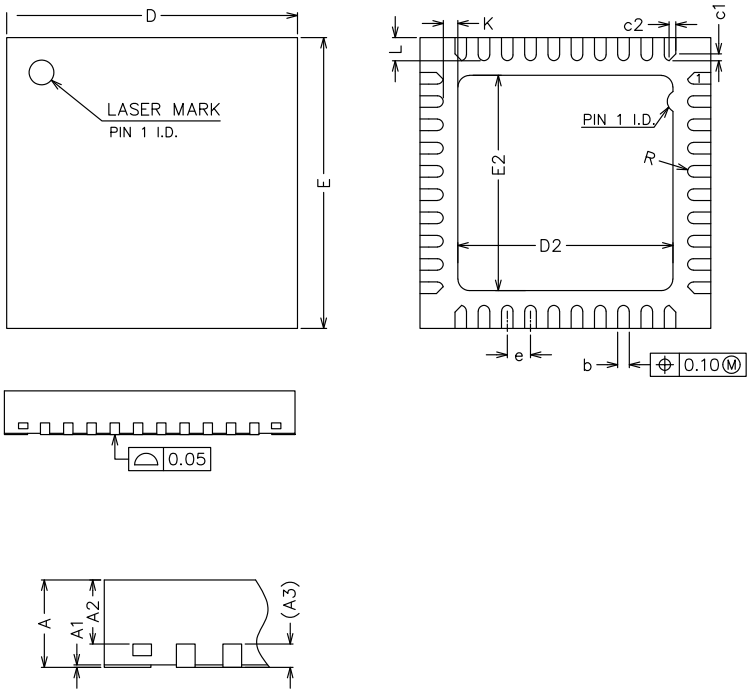
8.1 UC6580A (QFN40 Automotive)



SYMBOL	MIN	NOM	MAX
A	0.80	0.85	0.90
A1	0.00	0.02	0.05
A2	0.60	0.65	0.70
A3		0.20REF	
b	0.15	0.20	0.25
D	4.90	5.00	5.10
E	4.90	5.00	5.10
D2	3.60	3.70	3.80
E2	3.60	3.70	3.80
e	0.35	0.40	0.45
K	0.20	–	–
L	0.35	0.40	0.45
R	0.075	–	–
c1	–	0.10	–
c2	–	0.10	–

Figure 8-1 UC6580A (QFN40 Automotive) Mechanical Dimensions

8.2 UC6580I (QFN40 Industrial)



COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

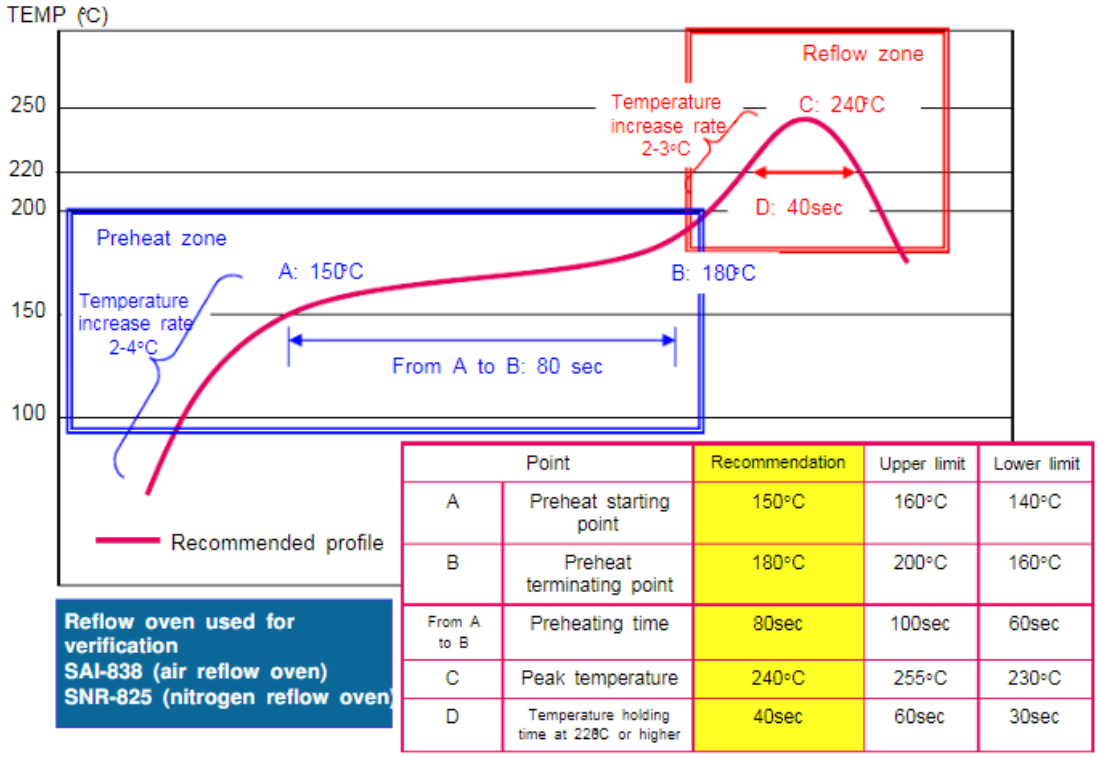
SYMBOL	MIN	NOM	MAX
A	0.80	0.85	0.90
A1	0	0.02	0.05
A2	0.60	0.65	0.70
A3		0.20REF	
b	0.15	0.20	0.25
D	4.90	5.00	5.10
E	4.90	5.00	5.10
D2	3.60	3.70	3.80
E2	3.60	3.70	3.80
e	0.35	0.40	0.45
K	0.20	–	–
L	0.35	0.40	0.45
R	0.09	–	–
C1	–	0.12	–
C2	–	0.12	–

NOTES:
ALL DIMENSIONS REFER TO JEDEC STANDARD MO–220 WHHE–1.

Figure 8-2 UC6580I (QFN40 Industrial) Mechanical Dimensions

9 Reflow Soldering

The reflow soldering temperature curve is recommended as shown in Figure 9-1 below (M705-GRN360 is recommended for solder paste).

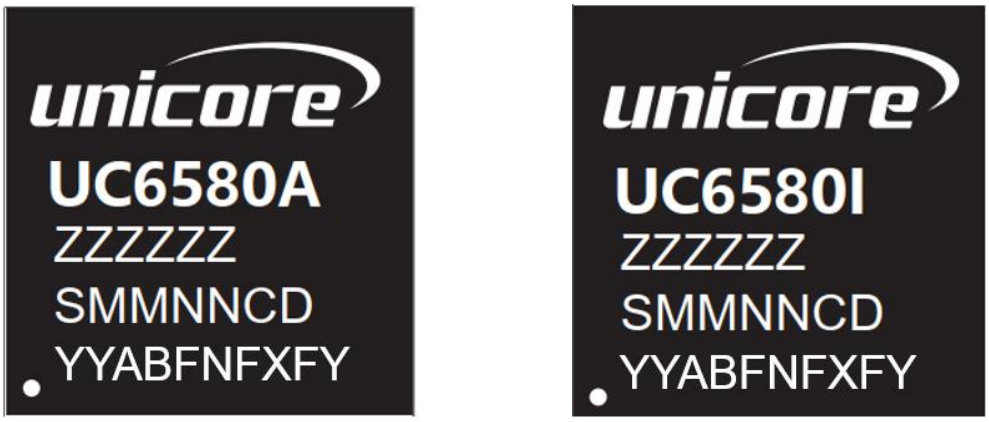


Point		Recommendation	Upper limit	Lower limit
A	Preheat starting point	150℃	160℃	140℃
B	Preheat terminating point	180℃	200℃	160℃
From A to B	Preheating time	80sec	100sec	60sec
C	Peak temperature	240℃	255℃	230℃
D	Temperature holding time at 228℃ or higher	40sec	60sec	30sec

Figure 9-1 Reflow Soldering Temperature Curve (QFN40)

10 Product Appearance and Packaging

10.1 Product Appearance



UC6580A (QFN40 Automotive) UC6580I (QFN40 Industrial)

Figure 10-1 UC6580 Product Appearance

10.2 Label

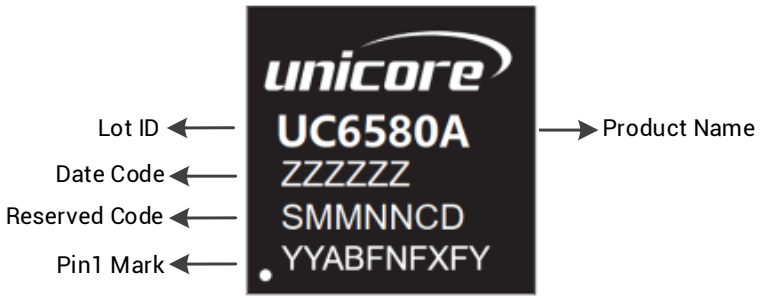


Figure 10-2 Label Description

Table 10-1 Code Description

Code	Description
UC6580	Product model
A	Automotive grade
I	Industrial grade

10.3 Ordering Information

Table 10-2 Ordering Information

Model	Chip Scale Package	Built-in Flash	Operating Temperature	Grade	Product Package
UC6580A	QFN40 5 mm × 5 mm × 0.85mm	Yes	-40 °C to 105 °C	Automotive	Tape & Reel, 3000 pcs/reel
UC6580I	QFN40 5 mm × 5 mm × 0.85mm	Yes	-40 °C to 85 °C	Industrial	Tape & Reel, 3000 pcs/reel

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