

1 REVISION HISTORY				
Version	Revision	Date	Author	comment
V1.0	Primary	Apr 9 2020	M.Heinzel	Primary version
V1.1	Primary	Oct 12 2020	M.Heinzel	Chapt.3.1 updated configuration table
V1.2	Beta Release	Nov 17, 2021	M.Heinzel	Chapt. 15 Extended CPN & MPN definition Chapt. 6.1 description for TP_6E corrected Heading and name adapted from GNS7000 / GNS7040 to GNS7000 series module
V1.3	Beta Release	Feb 4 , 2022	M.Heinzel	GNS7040 corrected CPN to GNS 7040-BABUR
V1.4	Beta Release	Mar 30 , 2022	M.Heinzel	New variant GNS7000-AABUR added
V1.5	Alpha Release	Okt 14 , 2022	M.Heinzel	Chapt. 3.1 : Corrections Chapt. 18 : Additional related documents available.
V1.6	Alpha Release	Okt 18 , 2022	M.Heinzel	Chapt. 3.1 : Wrong example corrected
V1.7	Alpha Release	Dec 15, 2023	M.Heinzel	Chapt. 4.1 : Correction of max. RF_IN input power

Document status

Primary:	Primary version, document content for design purpose, informal release
Alpha release:	Key customer preview version, document content has been preliminarily tested and verified, indicators may be fine-tuned later
Beta release:	Document content is verified by complete product testing and content indicators
Production release:	The document is complete and final

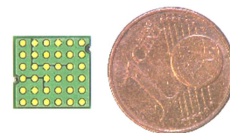
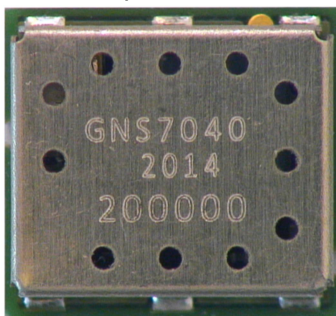
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3 INTRODUCTION

3.1 Overview

GNS7000 series modules provide a high performance and low power multi-GNSS solution in a small form factor enabling RF to NMEA solutions that minimize the load on the host processor.



Original size

Modules of the GNS7000 series are available in numerous variants, differing in protocol type, NMEA settings, I/O voltage, etc. The following table gives an overview of possible variants.

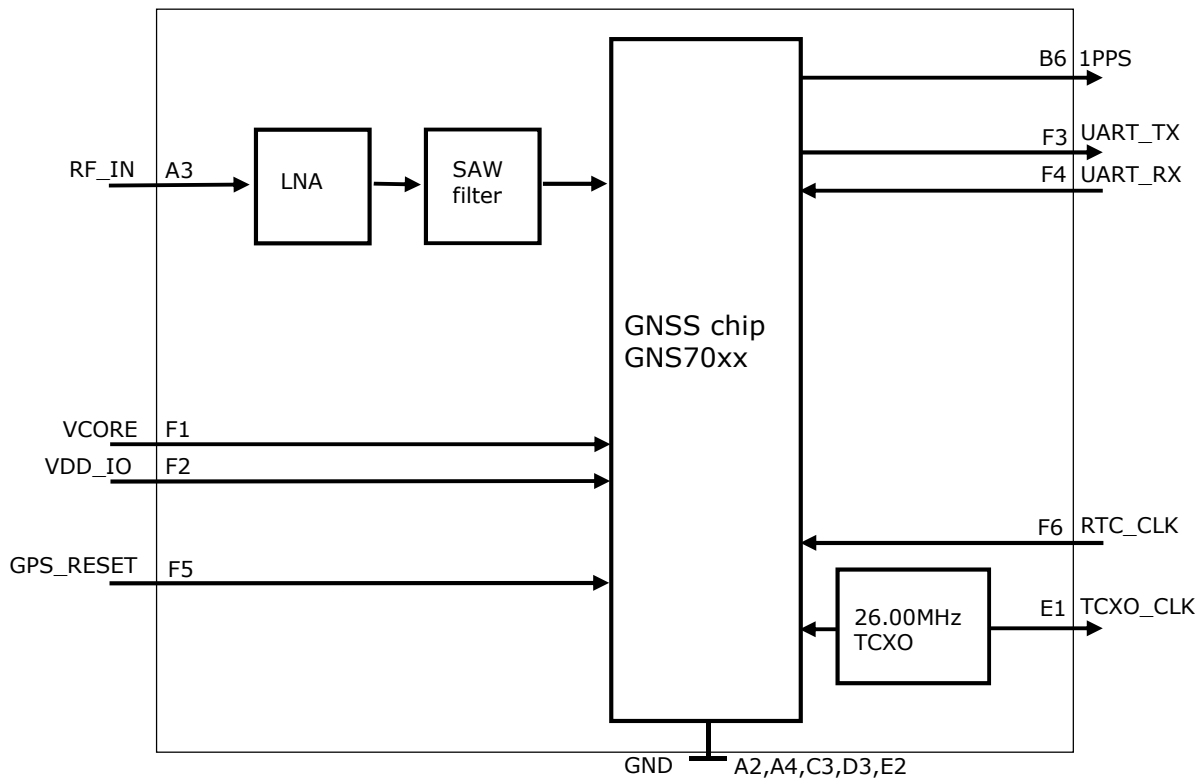
G	N	S	7	0	0	0	-	A	A	B	Y	R							
designation													variants			meaning			
G	N	S	7	0									product series			GNS7000 GNSS receiver series			
													0	4		0 : 1.8V 4 : 3.3V			
													0			0 : UART			
													A	B	C	A : GPS only B : GPS + GLONASS + GALLILEO C : GPS + BEIDOU			
													A			A : RMC + GGA + GLL + GSA + GSV + VTG @ 9600 bps			
													B	C	D	B : GNS7000_V1.01 C : GNS7000_2G_V1 D : GNS7000_6228CI_V1 E : RFU F : RFU			
													Y	U		GNS intern			
													R	T		R : Reel, 2000 pcs. T : Tape, smaller quantities available on request			

Example: GNS7000-AABYR -> I/O voltage = 1.8V, GPS only, h/w release 'B', shipped on reel (2000 pc.)
 GNS7000-BABUR -> I/O voltage = 1.8V, GPS+GLO+GAL only, h/w release 'B', shipped on reel (2000 pc.)
 GNS7040-BABUR -> I/O voltage = 3.6V, GPS+GLO+GAL only, h/w release 'B', shipped on reel (2000 pc.)

3.2 Key Features

Power				
VCore		1.8V		
VDD_IO	GNS7000-xxxxx	1.8V		
	GNS7040-xxxxx	3.3V		
Power Consumption		63mW		
RF Input				
Input VSWR		< 1.5		
Input Impedance		50Ω		
Antenna Gain		15 – 30 dB		
Physical Characters				
Dimension		9.3mm x 10.0mm		
Environment				
Operating Temperature		-45°C ~ +85°C		
Storage Temperature		-45°C ~ +90°C		
RoHS		Accord		
Data Interface				
UART		1 UART, LVTTTL. Baud rate 4800-115200bps		
GNSS Performance				
Frequency	GPS L1 :	1575.42 MHz		
	GLONASS L1 :	1602.5625 MHz		
	BEIDOU B1 :	1561.089 MHz		
TTFF	Cold Start :	30 s		
	Hot Start :	1 s		
	Reacquisition :	1 s		
Positioning Accuracy	2.0m CEP	dual-system horizontal, open sky		
	3.5m CEP	dual-system vertical, open sky		
Velocity Accuracy (RMS)		0.1m/s	dual-system, open sky	
Sensitivity		GPS	GLONASS	BEIDOU
	Tracking	-160 dBm	-161 dBm	-161 dBm
	Acquisition	-146 dBm	-146 dBm	-145 dBm
	Hot start	-152 dBm	-151 dBm	-147 dBm
	Reacquisition	-157 dBm	-157 dBm	-157 dBm
1PPS accuracy (RMS)		20ns		
Data updating rate		1 Hz		
Data output		NMEA 0183		

3.3 Block diagram



3.3.1 UART

GNS7000 series module supports data transfer and firmware upgrade, the signal input/output level is VDD_IO. The default baud rate is 9600bps, and is adjustable, can be configured up to 115200bps.

3.3.2 1PPS

GNS7000 series module outputs 1PPS with adjustable pulse width and polarity.

3.3.3 RTC_CLK

The RTC is driven internally by a 32768 Hz oscillator, which makes use of an external 32768Hz crystal. Besides that, the RTC can also be derived from the 26 MHz clock, which saves the external 32768Hz crystal.

3.3.4 VCore

The core voltage is 1.8V for all GNS7000 series modules.

3.3.5 VDD_IO

The IO voltage is 1.8V (GNS7000-xxxxx) & 3.3V (GNS7040-xxxxx).

4 ELECTRICAL SPECIFICATION

4.1 Absolute Maximum Ratings

Item		Min.	Typ.	Max.	Unit	Remarks
VCORE voltage	GNS7000-xxxxx	-0.20		1.98	V	
	GNS7040-xxxxx	-0.20		1.98	V	
VDD_IO voltage	GNS7000-xxxxx	-0.20		3.60	V	
	GNS7040-xxxxx	-0.20		3.60	V	
RF_IN input power				0	dBm	
Digital input voltage		-0.20		3.60	V	
RTC_CLK input voltage		-0.20		1.10	V	
Storage temperature		-50		150	°C	

4.2 Recommended Operating Conditions

Item		Min.	Typ.	Max.	Unit	Remarks
VCORE voltage		1.20	1.20	1.98	V	
VDD_IO voltage	GNS7000-xxxxx	1.70	1.80	1.90	V	
	GNS7040-xxxxx	2.80	3.30	3.60	V	
Environment temperature		-40	25	85	°C	

4.3 RF Parameters

Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
Receiver input frequency	Fin	1550	1575.42	1620	MHz	
LNA input impedance	LNA_IN		50		Ω	
TCXO frequency	TCXO_Freq		26		MHz	

4.4 DC Characteristics Digital IO

Item			Symbol	Min.	Typ.	Max.	Unit	Remarks
Input voltage	GNS7000-xxxxx	H level	V _{IH}	1.20		1.90	V	
		L level	V _{IL}	-0.20		0.60	V	
	GNS7040-xxxxx	H level	V _{IH}	1.20		3.60	V	
		L level	V _{IL}	-0.20		0.70	V	

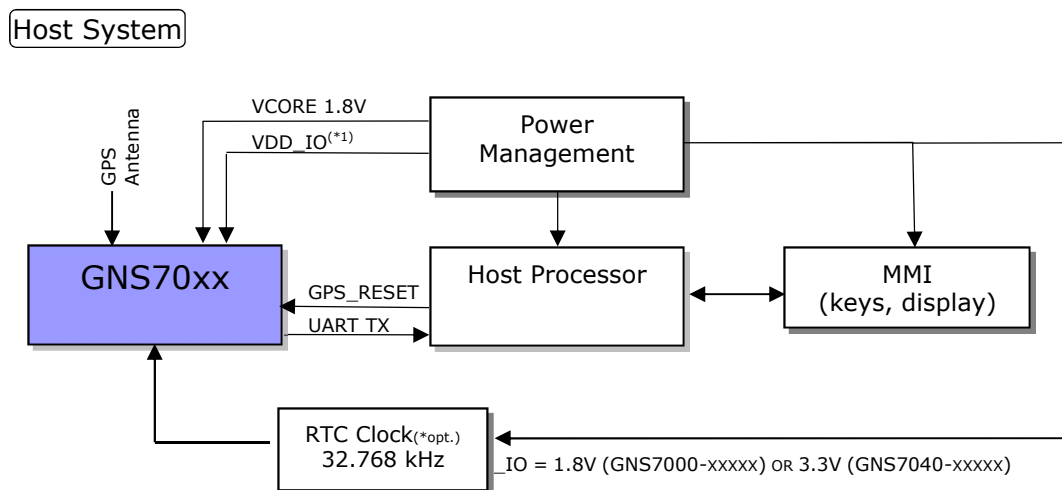
4.5 Analog Parameters

Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
RTC_CLK frequency	RTC_Fxtal		32768		Hz	
RTC_CLK startup time	RTC_T_start	0.2	1	2	s	
RTC_CLK oscillator amplitude	RTC_Amp	50		350	mVpp	

4.6 Current consumption

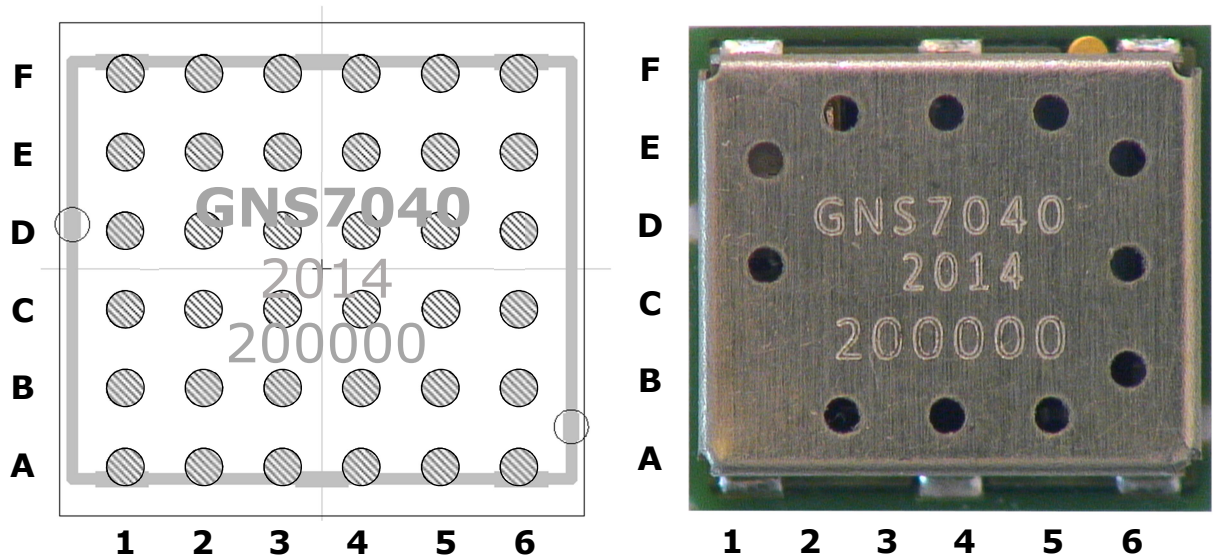
Parameter	Min	Typ	Max	Unit	Condition
Peak current			37	mA	T.B.D.
Tracking average current	19	20	21	mA	T.B.D.

5 TYPICAL APPLICATION BLOCK DIAGRAM



6 DEVICE PINOUT DIAGRAM

TOP VIEW



F	VCORE	VDD_IO	UART_TX	UART_RX	NRESET	RTC_CLKI
E	TCXO_CLKO	GND	UART_CTS	NU_4E	NU_5E	TP_6E
D	NU_1D	NU_2D	GND	NU_4D	NU_5D	NU_6D
C	NU_1C	NU_2C	GND	NU_4C	NU_5C	NU_6C
B	NU_1B	NU_2B	NU_3B	NU_4B	NU_5B	1PPS_OUT
A	NU_1A	RF_GND	RF_IN	RF_GND	NU_5A	NU_6A

6.1 Pin Description

NO	NAME	TYPE ¹	DESCRIPTION
Power-Management Signals			
2F	VDD_IO	P	GNS7000 : 1.8V I/O power supply voltage
			GNS7040 : 3.3V I/O power supply voltage
1F	VCORE	P	1.8V main power supply voltage (GNSS core voltage)
3D	GND	P	Common Ground
2E	GND	P	Common Ground
3C	GND	P	Common Ground
Clock Signals			
1E	TCXO_CLKO	O2	TCXO_CLK signal output. This Pin delivers the high stable TCXO frequency of 26.000 MHz for external components. Although the output is buffered, do not load this pin below 20kOhms // 10pF (TBD). Leave open if not used.
6F	RTC_CLKI	I1	Clock input: 32.768 kHz. External input for internal RC oscillator. The RTC_CLKI should be tied with GND if an external RTC clock isn't used.
GPS Signals			
3A	RF_IN	ANA	GNSS RF Input, direct connection of passive or active GNSS antenna
2A	RF_GND	ANA	GNSS RF Ground
4A	RF_GND	ANA	GNSS RF Ground
6B	1PPS_OUT	O1	This output delivers a high-precision pulse-per-second signal that is synchronized to the GNSS time reference. The pulse precision is better than $1 \cdot 10^{-7}$ seconds. Leave open if not used.
5F	NRESET	I1	Reset input, LOW active. Pull up (or leave open) during operation.
6E	TP_6E		Test point, pull up (or leave open) during operation.
UART			
3F	UART_TX	O1	Main UART TX.
4F	UART_RX	I1	Main UART RX.
3E	UART_CTS	I1	Main UART CTS.
NOT USED PINS			
1A	NU_1A		Not used , internally not connected
1B	NU_1B		Not used , internally not connected
1C	NU_1C		Not used , internally not connected
1D	NU_1D		Not used , internally not connected
2B	NU_2B		Not used , internally not connected
2C	NU_2C		Not used , internally not connected
2D	NU_2D		Not used , internally not connected
3B	NU_3B		Not used , internally not connected
4B	NU_4B		Not used , internally not connected
4C	NU_4C		Not used , internally not connected
4D	NU_4D		Not used , internally not connected
4E	NU_4E		Not used , internally not connected
5A	NU_5A		Not used , internally not connected
5B	NU_5B		Not used , internally not connected
5C	NU_5C		Not used , internally not connected
5D	NU_5D		Not used , internally not connected
5E	NU_5E		Not used , internally not connected
6A	NU_6A		Not used , internally not connected
6C	NU_6C		Not used , internally not connected
6D	NU_6D		Not used , internally not connected

- (1) I1 = INPUT (VDD_IO DOMAIN); I2 = INPUT (VCORE DOMAIN);
 O1 = OUTPUT (VDD_IO DOMAIN); O2 = OUTPUT (VCORE DOMAIN);
 P = POWER PIN; ANA = ANALOG PIN.

7 HARDWARE HOST INTERFACE

GNS7000 series modules are connected to the host system via a UART. NMEA data but also commands and responses are transmitted via this interface.
The interface voltage domain is VDD_IO.

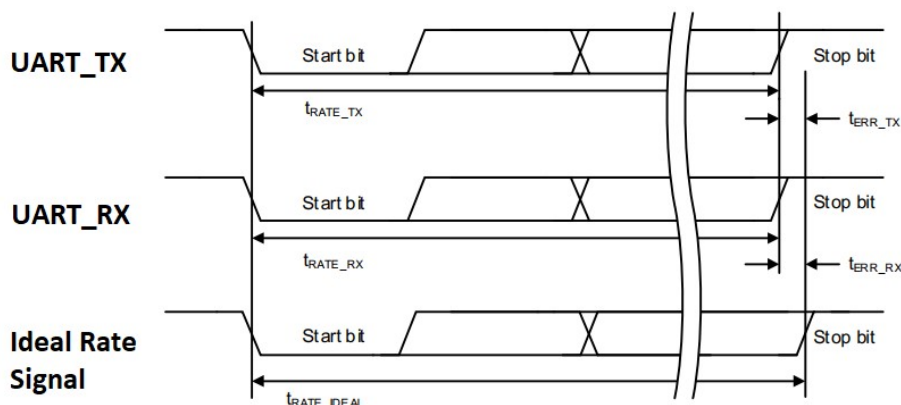
The idle state of the lines is positive voltage. To interface a standard RS232 UART (e.g. a PC serial interface), please add an inverting level shifter. To interface processors that have a different interfacing voltage level, level shifters are required.

7.1 GPS UART Interface details

- The UART interface is used to send NMEA messages and control data.
- The default baud rate is 9600, other baud rates can be selected by ordering option.

GPS UART Default Settings	
Parameter	Value
Baud rate	9600
Data length	8 bits
Stop bit	1
Parity	None

7.2 GPS UART AC characteristics



GPS UART Error Tolerance						
Item	Symbol	Min.	Typ.	Max	Unit	Remarks
UART Error Rate	R _{BRT_ERR}	-1		1	%	T _{err_TX} / t _{rate_IDEAL}

8 NMEA DATA

The GNS7000 series module outputs below sentences of NMEA0183 compliant sentences.
All active NMEA sentences are sent at the selected rate.

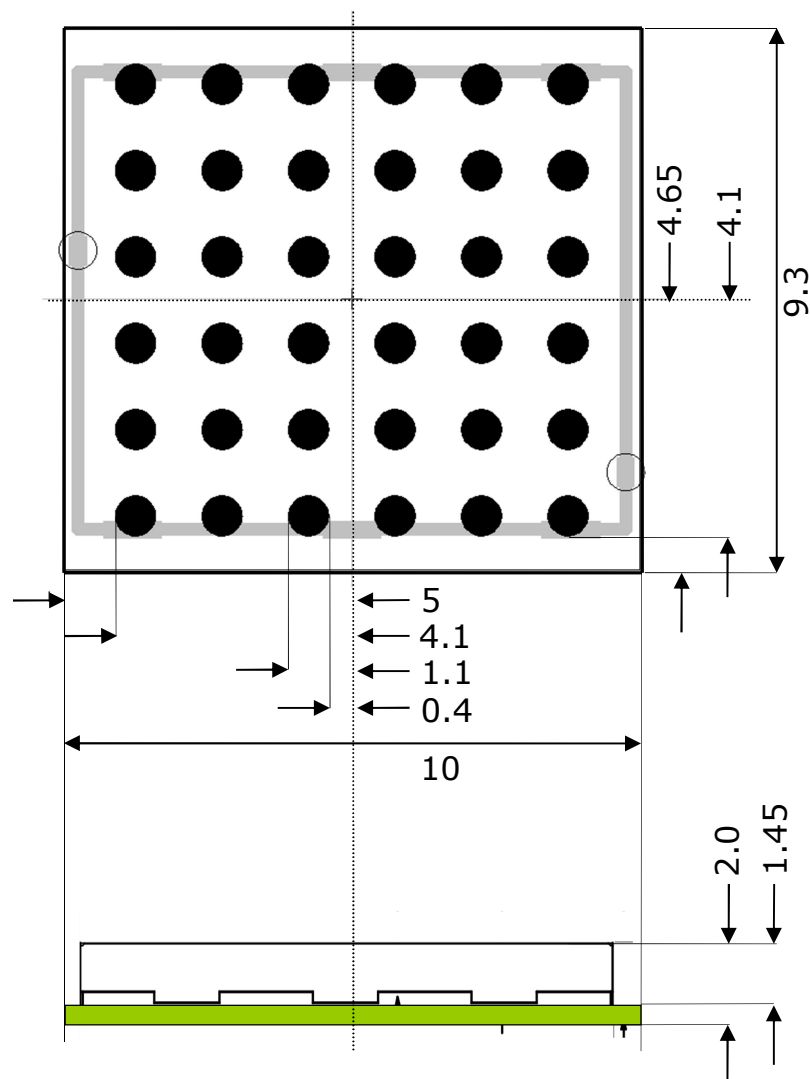
NMEA available sentences			
Header	Talker ID ^{*Note1}	Type	Content ^{*Note2}
\$	GP : Using only GPS for positioning GL : Using only GLONASS for positioning BD : Using only BeiDou for positioning GQ : Using only QZS for positioning GN : Using combined satellite systems for positioning	RMC	Recommended Minimum Navigation Information
	GP	GGA	Global Positioning System Fix Data, Time, Position and fix related data for a GPS receiver
	GP : Using only GPS for positioning GL : Using only GLONASS for positioning BD : Using only BeiDou for positioning GQ : Using only QZS for positioning	GSV	Satellites in view
	GP : Using only GPS for positioning GL : Using only GLONASS for positioning BD : Using only BeiDou for positioning GQ : Using only QZS for positioning GN : Using combined satellite systems for positioning	GLL	Geographic Position - Latitude/Longitude
	GP : Using only GPS for positioning GL : Using only GLONASS for positioning BD : Using only BeiDou for positioning GQ : Using only QZS for positioning GN : Using combined satellite systems for positioning	GSA	GPS DOP and active satellites
	GP : Using only GPS for positioning GL : Using only GLONASS for positioning BD : Using only BeiDou for positioning GQ : Using only QZS for positioning GN : Using combined satellite systems for positioning	VTG	Track made good and Ground speed

Note1: The Talker ID depends on the preset and currently receivable satellite systems.

Note2: For more detailed information on the individual sentences please refer to the NMEA specification.

9 PHYSICAL DIMENSIONS

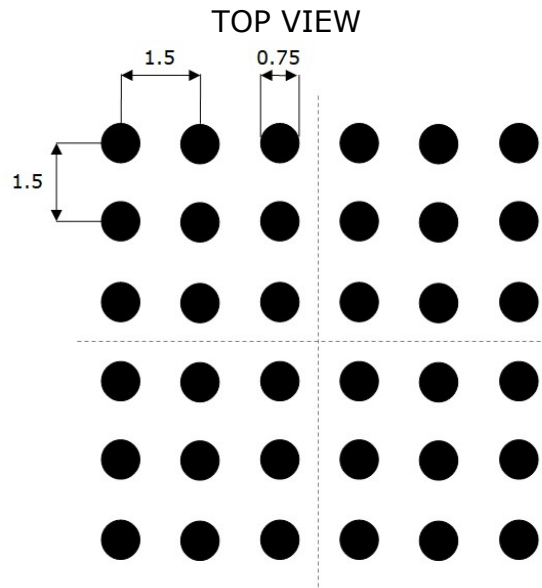
TOP VIEW



all units in mm

tolerance : $\pm 0.1\text{mm}$ for $< 5\text{mm}$, $\pm 0.2\text{mm}$ for $\geq 5\text{mm}$

10 RECOMMENDED PAD LAYOUT



all units in mm

11 MATERIAL INFORMATION

Contact surface : gold over nickel

11.1 Shield Material Information

"German Silver " , CuNi18Zn27

Cu: 53.5..56.5%

Ni : 16.5..19.5%

Zn : 24..30%

thickness :0.2mm

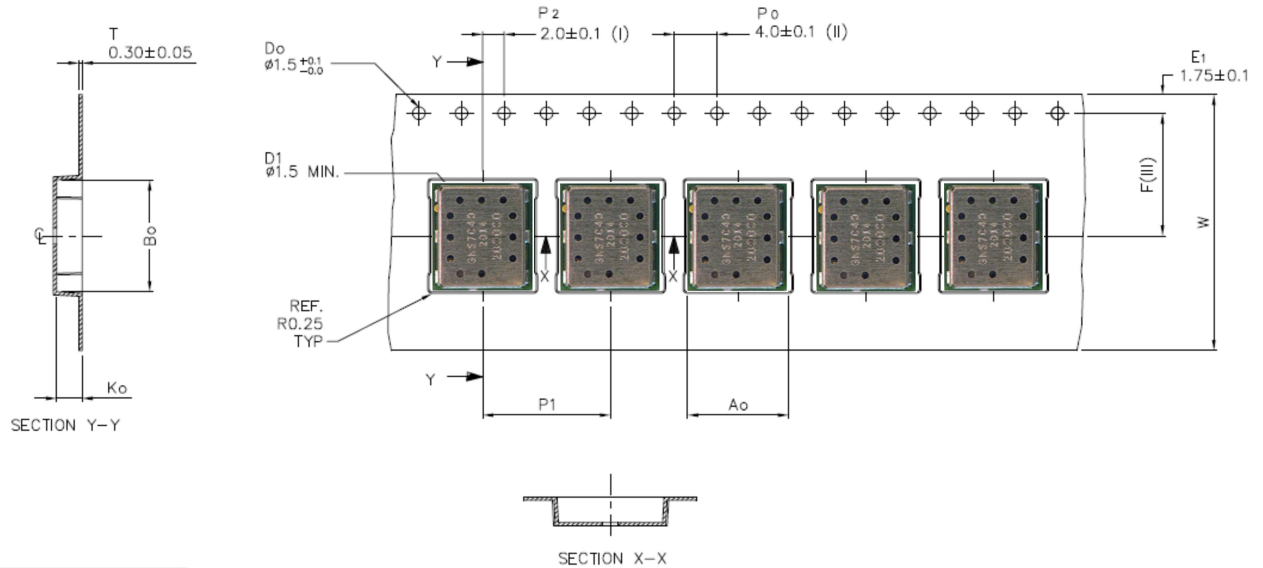
12 RECOMMENDED SOLDERING REFLOW PROFILE



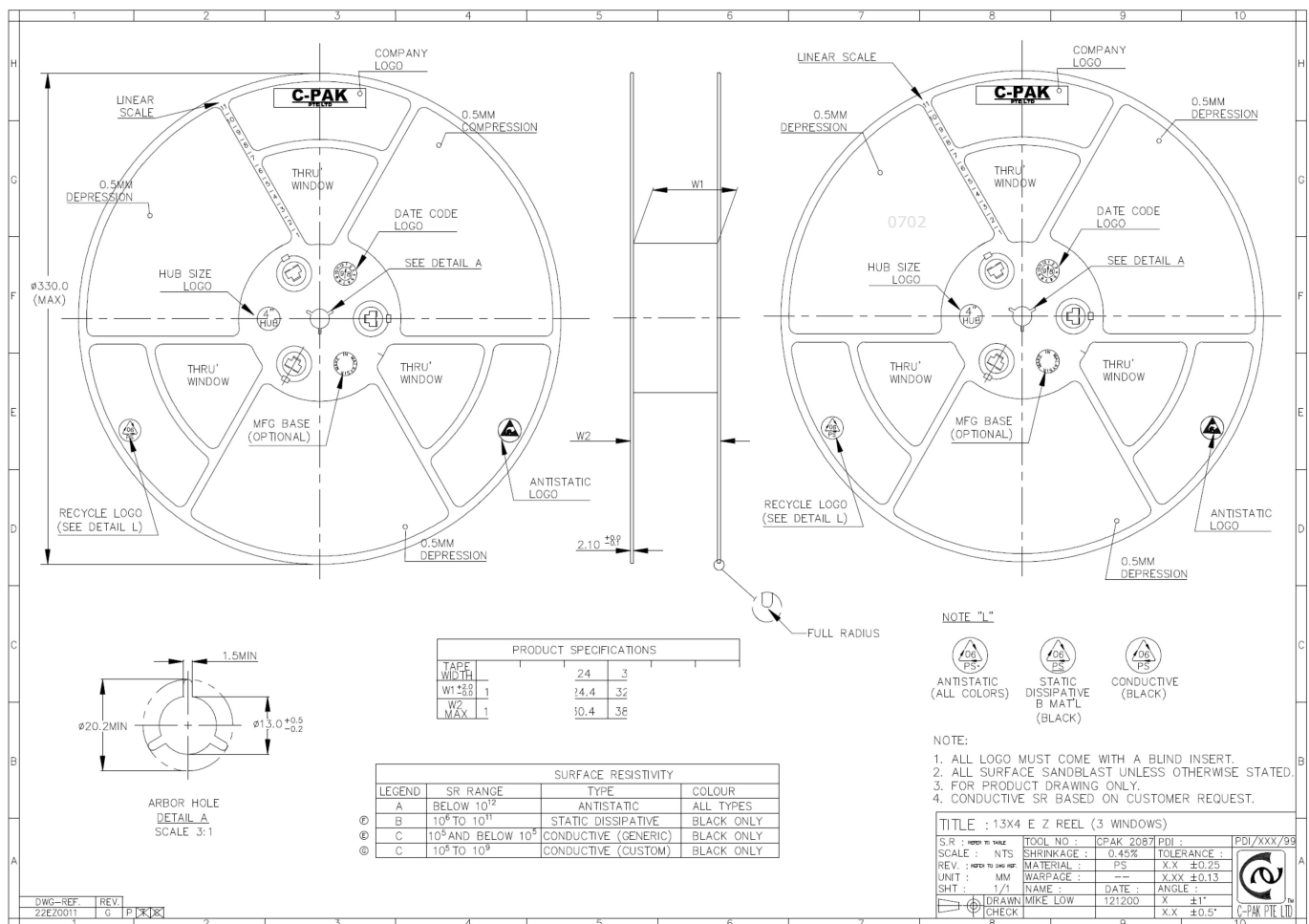
Notes:

1. GNS7000 series module should be soldered in upright soldering position. In case of head-over soldering, please prevent shielding / module from falling down.
2. Do never exceed maximum peak temperature
3. Reflow cycles allowed: 1 time
4. Do not solder with PB-Sn or other solder containing lead (PB)
5. This device is not applicable for flow solder processing
6. This device is not applicable for solder iron process

13 TAPE INFORMATION



14 REEL INFORMATION



no. of devices : 2000 pcs / reel

15 ORDERING INFORMATION

Modules of the GNS7000 series are available in numerous variants, differing in protocol type, NMEA settings, I/O voltage, etc. Each of these variants is assigned a unique MPN and CPN. The following table gives an overview of possible variants.

15.1 GNS7000 series module product variants														
GNS70	0	0-	x	x	x	x	x	designation	variants					description
GNS70								product series					GNS7000 GNSS receiver series	
	0							I/O voltage	0	4			0 : 1.8V 4 : 3.3V	
		0-						protocol type	0				0 : UART	
			x					function features	A	B			A : GPS only B : GPS + GLO + GAL Other function features are available	
				x				NMEA settings	A				A : RMC + GGA + GLL + GSA + GSV + VTG @ 9600 bps Other NMEA settings are available	
					x			h/w release	B				B : GNS7000_V1.01	
						x		GNS intern	Y	U				
							x	packing	R	T	S		R : Reel, 2000 pcs. T : Tape, smaller quantities available on request S : Single quantities, available on request	

15.2 GNS7000 series module ordering information			
Type (CPN)	Part# (MPN)	Laser marking	Description
GNS 7000-AABYR	4037735106505	GNS7000 AABY yy cw <serial#>	GNSS Module (I/O voltage = 1.8V) with standard options. Reel packing
GNS 7000-AABYT	4037735106512	GNS7000 AABY yy cw <serial#>	GNSS Module (I/O voltage = 1.8V) with standard options. Tape packing
GNS 7040-BABUR	4037735106338	GNS7040 BABU yy cw <serial#>	GNSS Module (I/O voltage = 3.3V) with standard options
GNS 7000-AABUR	4037735106598	GNS7000 AABU yy cw <serial#>	GNSS Module (I/O voltage = 1.8V) with standard options

Note: other variants are available on request

16 ENVIRONMENTAL INFORMATION

This product is free of environmental hazardous substances and complies to 2015/863/EU. (RoHS 3 directive).

RoHS 3
COMPLIANT
2015/863/EU

16.1 Quality and Environmental Specifications

Test	Standard	Parameters
PCB Inspection	IPC-6012B, Class 2. Qualification and Performance Specification for Rigid Printed Boards - Jan 2007	
Assembly Inspection	IPC-A-610-D, Class 2 "Acceptability of electronic assemblies"	
Temperature Range	ETSI EN 300 019-2-7 specification T 7.3	-30 °C, +25 °C, +85 °C, operating
Damp Heat	ETSI EN 300 019-2-7 specification T 7.3	+70 °C, 80% RH, 96 hrs, non-operating
Thermal Shock	ETSI EN 300 019-2-7 specification T 7.3 E	-40 °C ... +85 °C, 200 cycles
Vibration	ISO16750-3	Random vibration, 10~1000Hz, 27.8m/s ² , 8hrs/axis, X, Y, Z 8hrs for each 3 axis non-operating
Shock	ISO16750-3	Half-sinusoidal 50g, 6ms, 10time/face, ±X, ±Y and ±Z non-operating
ESD Sensitivity	JEDEC, JESD22-A114 ESD Sensitivity Testing Human Body Model (HBM), Class 2 JEDEC, JESD22-A115 ESD Sensitivity Testing Machine Model (MM), Class B	+2000V - Human hand assembly +250V - Machine automatic final assembly
Moisture/Reflow Sensitivity	IPC/JEDEC J-STD-020	MSL3
Storage (Dry Pack)	IPC/JEDEC J-STD-033C	MSL3
Solderability	EN/IEC 60068-2-58 Test Td	More than 90% of the electrode should be covered by solder. Solder temperature 245 °C ± 5 °C

Moisture Sensitivity

GNS ships all devices dry packed in tape on reel with desiccant and moisture level indicator sealed in an airtight package. If on receiving the goods the moisture indicator is pink in color or a puncture of the airtight seal packaging is observed, then follow J-STD-033 "Handling and Use of Moisture/Reflow Sensitive Surface Mount Devices".

Storage (Out of Bag)

The GNS7000 series modules meet MSL Level 3 of the JEDEC specification J-STD-020D – 168 hours Floor Life (out of bag) ≤30 °C/60% RH. If the stated floor life expires prior to reflow process then follow J-STD-033 "Handling and Use of Moisture/Reflow Sensitive Surface Mount Devices".

17 PACKAGING

1 reel		
contents	2,000pcs	
GNS part#	2 x 6550000003 1 x 6550000011	
dimensions	dia: 330mm thickness:30.4mm	
gross weight	1.195 Kg	with full contents
net weight	0.246 Kg	
2 vacuum bag		
GNS part#	6550000006	
dimensions	400mm x 480mm	
gross weight	1.321 kg	with full contents
net weight	0.068 Kg	
air pressure level	<30mbar	
3 moisture indicator		
GNS part#	6550000008	
dimensions	76mm x 51mm	
weight	0.001 Kg	
4 dry pack		
GNS part#	6550000007	
dimensions	145mm x 140mm	
weight	0.068 Kg	
5 Box for reel		
GNS part#	6550000012	
dimensions	350 mm x 350mm x 47mm	
gross weight	1.5357 kg	with full contents
net weight	0.184 kg	
6 Outer box		
contents	max 7 box for reel	(14,000 pcs GNS70xx-xxxxx)
dimensions	400mm x 370mm x 360mm	
gross weight	11.6 kg	with full contents
net weight	0.85 kg	

18 RELATED DOCUMENTS

Type	description	Available from
<i>GNS 70x0 StarterKit UserManual Quick Guide</i>	<i>A short summary of the most important features of the GNS 7000 / GNS 7040 StarterKit</i>	GNS Electronics GmbH
<i>GNS7000 design guide</i>	<i>Contains information about implementation of the module and antenna design</i>	The document is currently not yet available.
<i>GNS70x0_StarterKit_UserManual</i>	<i>Hardware manual for the GNS Starter Kit</i>	GNS Electronics GmbH
<i>GNS70x0_CommandInterface_manual</i>	<i>Command description for GNS70x0 series module</i>	GNS Electronics GmbH

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