

### 1 INTRODUCTION

GNS-Electronics introduces the new GNS 5851 AIS receiver module for the maritime market.

The GNS 5851 is a highly sensitive single-channel receiver which can either be used stand-alone as a channel hopping receiver or as a chained pair to form a complete two channel solution depending on customer needs.

The module integrates a sensitive RF frontend, signal processing and a data decoder with standard NMEA AIS output via a UART that can be easily connected to a host processor. A secondary UART is provided for module chaining.

#### Features

- Standard AIS NMEA output
- Sensitivity -117 dBm
- Selectable Channel A, B or A & B (hopping)
- Small outline 26x15x3.3mm
- Ultra-Low power consumption : 20 mA
- Frame decode indicator output
- Easy to mount stamp hole PCB design
- Evaluation Board with USB bridge available



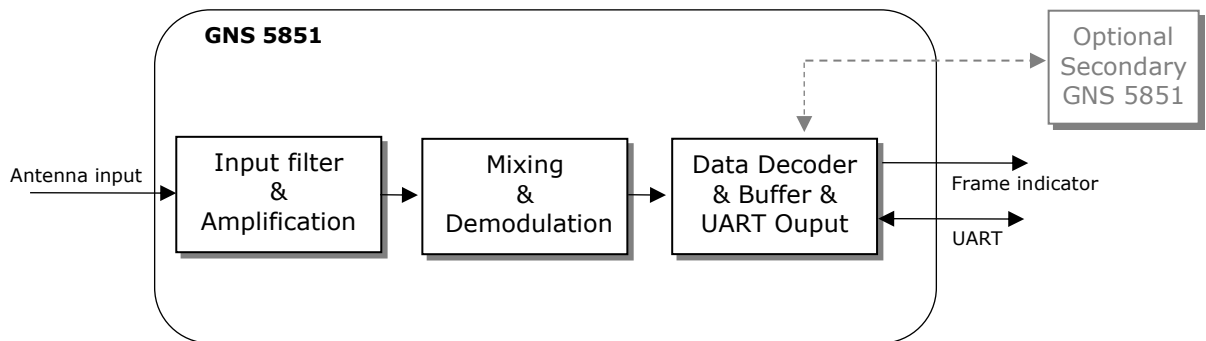
#### Applications

- Maritime safety
- Shore/Harbour equipment
- Data loggers for internet based online marine tracking systems

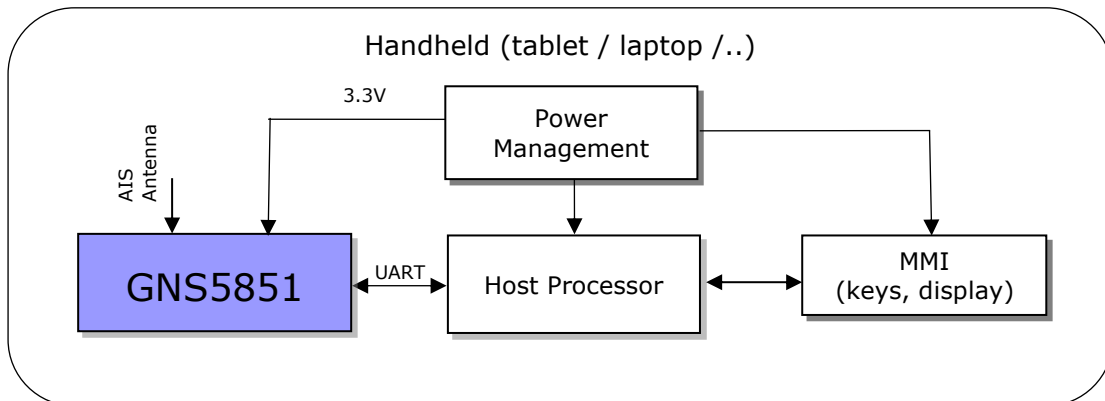
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### 3 BLOCK DIAGRAM



### 4 TYPICAL APPLICATION BLOCK DIAGRAM



### 5 DETAILED DESCRIPTION

GNS 5851 is a high performance single channel receiver for the marine Automatic Identification System (AIS). It receives the Marine Band channels 87B (Ch. A) and 88B (Ch. B) at 161.975 MHz and 162.025 MHz respectively and can be configured to statically receive either channel or to automatically hop between channels. Two GNS 5851 can be chained to form a continuous two-channel AIS receiver if necessary.

Only an appropriate power supply of 3.3V and a suitable antenna must be connected for operation, no external clocks are required.

The GNS 5851 outputs all received AIS data as standard NMEA messages via its UART at 115200 baud using 3.3V levels.

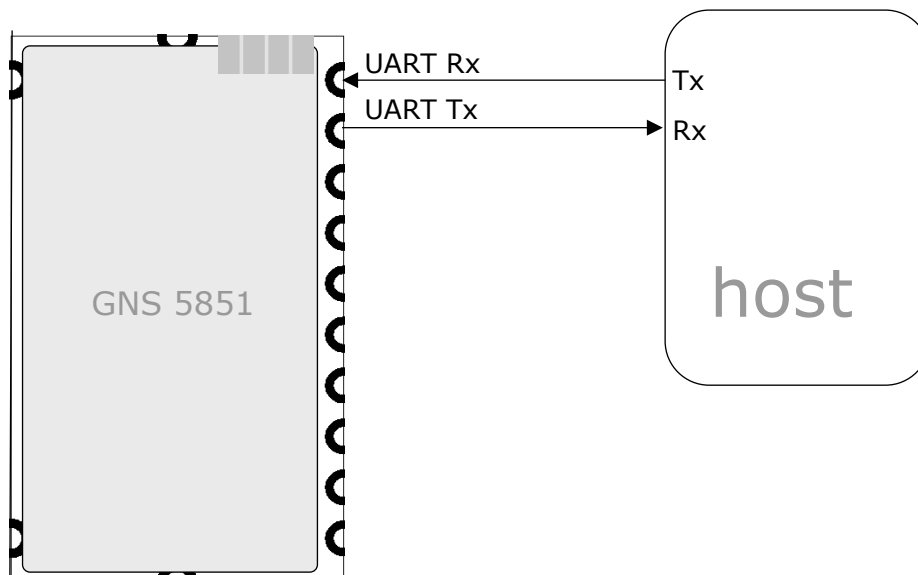
#### 5.1 UART Interface details

GNS 5851 must be connected to the host system via a UART Interface.

Transmission protocol is industry standard NMEA 0183 using VDM sentences for received vessel data, see <https://www.nmea.org> for reference.

I/O levels are 3.3V (see electrical data), baudrate is 115200 bps using 8 data bits, one stop bit and no parity ('8-N-1')

The idle state of the UART 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.



### 5.2 Power supply

GNS 5851 needs a single power supply of 3.1 .. 3.5V. The current consumption is ~15mA at full operation.

### 5.3 Reset input

The reset input is optional. Drawing this pin to low will reset the internal microprocessor. Reset can be left open for the most applications.

### 5.4 Frame available output

The frame available signal is used to indicate frames being successfully decoded. The pin will be set to high whenever a frame or a block of frames come in. The signal can be used by a host processor or may drive a LED to provide a visual feedback of the incoming data frames.

### 5.5 RF input (RFIn)

The RF input pin has a nominal impedance of 50 Ohms. Please keep tracks from module to antenna connector as short as possible. If more than a few millimetres track length is needed, the tracks must be impedance controlled (e.g. microstrip line).

On request, GNS can offer RF-support regarding PCB design.

### 5.6 AIS VHF antenna

For antenna installation, keep I mind that VHF signals will spread near-linear only ("line-of-sight"). Any obstacles like buildings, mountains or woods will attenuate or even totally block the signal.

The VHF antenna should be mounted at an elevated location with an unobstructed "view" in the desired direction.

**ATTENTION: Risk of fire and injury ! For any raised mounted antenna constructions like roof antennas or aerial masts, it's mandatory to follow the rules for lightning protection.  
In case of doubt please consult a professional specialist**

### 6 ELECTRICAL SPECIFICATION

6.1 Absolute Maximum Ratings		
Parameter	Value	Unit
Supply voltage range: $V_{dd}$	0 to 3.8	V
DC Input voltage to antenna port	-0.3 to $V_{dd} + 0.3$	V
Max. RF input to antenna port (in-band & out-of-band)	+10	dBm
Input voltage to all other pins	-0.3 to $V_{dd} + 0.3$	V
Operating ambient temperature range	-40 to +85	°C
Storage temperature range	-40 to +85	°C

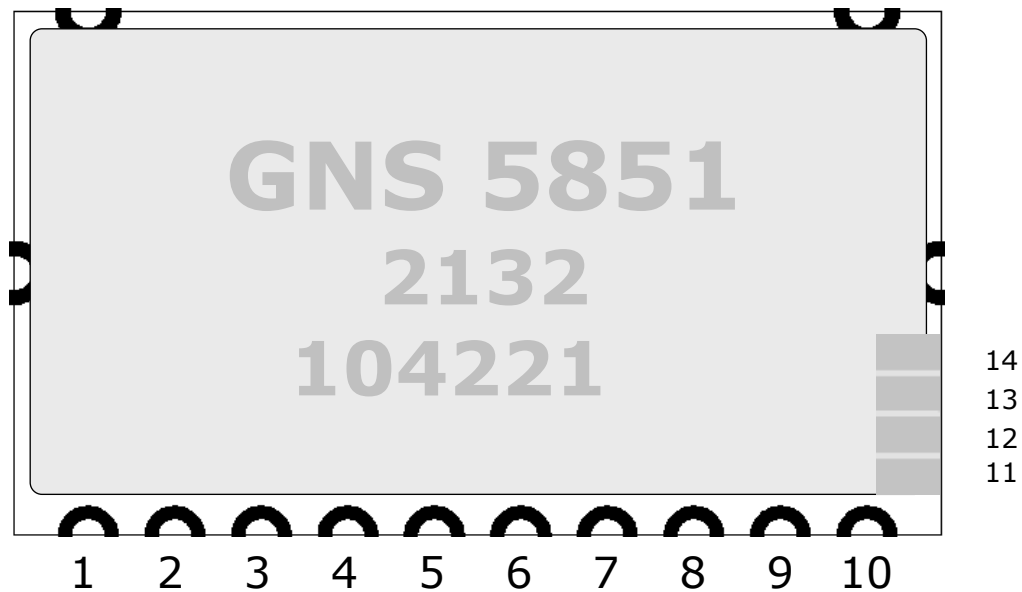
6.2 Recommended Operating Conditions					
Parameter	Min	Typ	Max	Unit	Note
$V_{dd}$	3.1	3.3	3.5	V	Power-supply voltage
High level output voltage $V_{OH}$	2.4		$V_{dd}$	V	$I_{source} = 3 \text{ mA}$
Low level output voltage $V_{OL}$	0		0.7	V	$I_{sink} = 3 \text{ mA}$
Operating temperature	-40		+80	°C	Full specified performance

6.3 Characteristics					
Parameter	Min	Typ	Max	Unit	Note
General					
Frequency	161.95		162.05	MHz	Marine Band VHF channels 87B & 88B
Output data bit rate		115200		Bit/sec	NMEA 0183 protocol
UART baud deviation			0.7	%	
Sensitivity	-115	-117	-118	dBm	
Max. Usable Input Level			+10	dBm	
Power Consumption					
Average current (full operation)	19.5	19.9	21.0	mA	
Supply voltage	3.1	3.3	3.5	V	

6.4 RF input characteristics					
Parameter	Min	Typ	Max	Unit	Note
Input impedance		50		$\Omega$	
Maximum input level			+10	dBm	before destruction

### 7 DEVICE PINOUT DIAGRAM

TOP VIEW



Pin	Name	I/O	Description & Note
1	RF Gnd	G	Antenna Ground
2	RF in	Ana	RF input AIS VHF signal input pin.
3	Gnd	G	Supply Ground
4	Vdd	P	Main Supply voltage 3.3V
5	F_ind	O	Frame indicator Outputs positive pulses when receiving single AIS frames or groups of AIS frames.
6	RESET	I	Reset input. Low active, causes the module to reset. Internally pulled up by 40 kOhm, if not used keep floating.
7	NC	-	Do not connect. Leave pin open.
8	NC	-	Do not connect. Leave pin open.
9	UART Tx	O	Data from GNS 5851 -> Host
10	UART Rx	I	Commands from Host -> GNS 5851
11	NC	-	Tbd (chaining interface)
12	NC	-	Tbd (chaining interface)
13	NC	-	Tbd (chaining interface)
14	NC	-	Tbd (chaining interface)

G=Ground; Ana = analogue; P=power supply; O= dig. Output(3.3V); I=digital Input(3.3V)

### 8 AIS DATA

AIS data itself is defined in ITU-R standard M.1371-5 which is freely available from the ITU website:

<https://www.itu.int/rec/R-REC-M.1371/en>

The encoding as NMEA 0183 VDM sentence is defined in the NMEA 0183 standard that can be obtained from the NMEA: [https://www.nmea.org/content/STANDARDS/NMEA\\_0183\\_Standard](https://www.nmea.org/content/STANDARDS/NMEA_0183_Standard)

As an overview we can highly recommend Eric S. Raymond's excellent and very readable description of AIS and its encoding as part of the open-source GPSD project: <https://gpsd.gitlab.io/gpsd/AIVDM.html>



### 9 COMMAND INTERFACE

The command interface is NMEA 0183 based using private sentences that start with '\$PGNS'.

The general command structure is

```
$PGNS, C[, param1 [, param2 ...]] *XX<CR><LF>
```

**C** is a single upper-case character unique for each command  
param1... are optional parameters for a specific command  
XX is the standard NMEA 0183 checksum

Each command will be answered with a reply that has the following structure:

```
$PGNS, 0, C[, rpl1 [, rpl2 ...]] *XX<CR><LF>
```

**C** is the same single upper-case character as the command  
rpl1... are optional reply data for a specific command/reply  
XX is the standard NMEA 0183 checksum

#### 9.1 Command Sentences (Host → Device)

The following paragraphs describe each command/reply in detail.

##### 9.1.1 Version Request

Command: \$PGNS, V\*70<CR><LF>

Reply: \$PGNS, 0, V, GNS5851, <fw-version>, <loader-version>, xxx\*XX<CR><LF>

Example: -> \$PGNS, V\*70  
<- \$PGNS, 0, V, GNS5851, 21.6.1, 1.0-1, S01\*5A  
Firmware Version is 21.6.1

### 9.1.2 Set Receiver Mode

Command: \$PGNS,**M**,<mode>\*XX<CR><LF>

<mode> - Reception mode:

'A' - Channel A only

'B' - Channel B only

'H' - Alternating channel A and B (hopping)

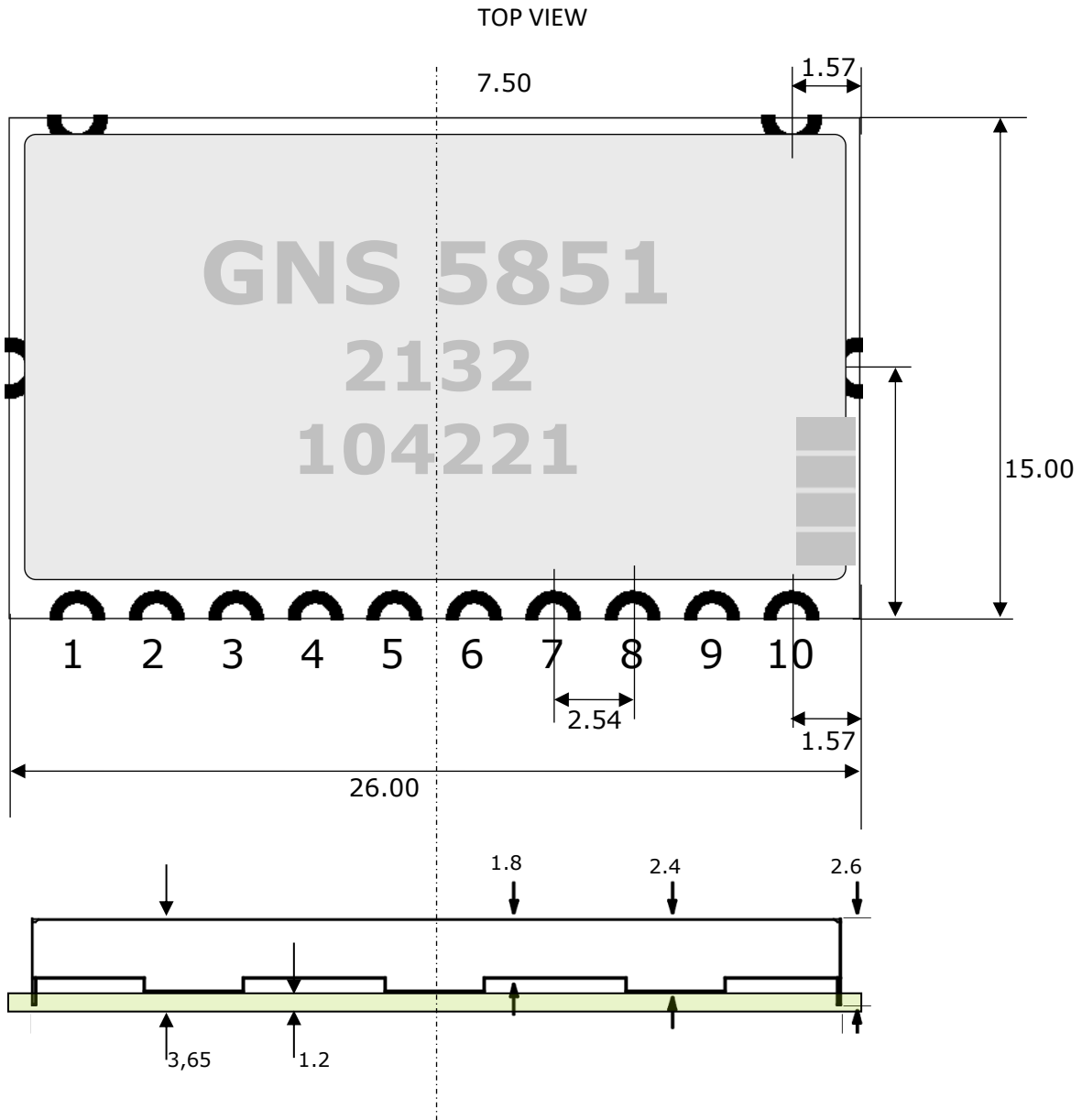
Reply: \$PGNS,0,**M**,OK\*5F<CR><LF>

Example: Receive channel A only:

-> \$PGNS,M,A\*06

<- \$PGNS,0,M,OK\*5F

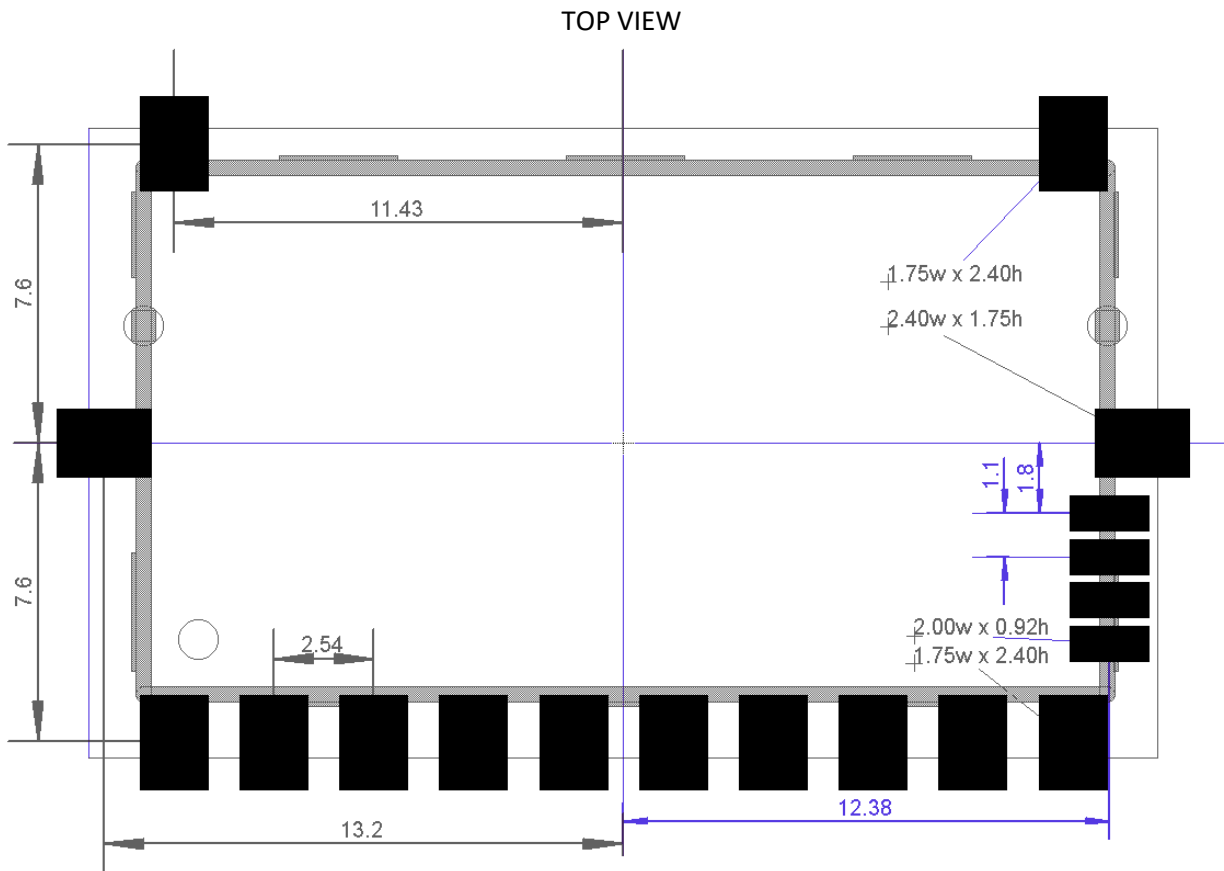
### 10 PHYSICAL DIMENSIONS



all units in mm

tolerance +/- 0.1 mm

### 11 RECOMMENDED PAD LAYOUT



all units in mm

### 12 MATERIAL INFORMATION

#### 12.1 Shield Material Information

"German Silver " , CuNi18Zn27

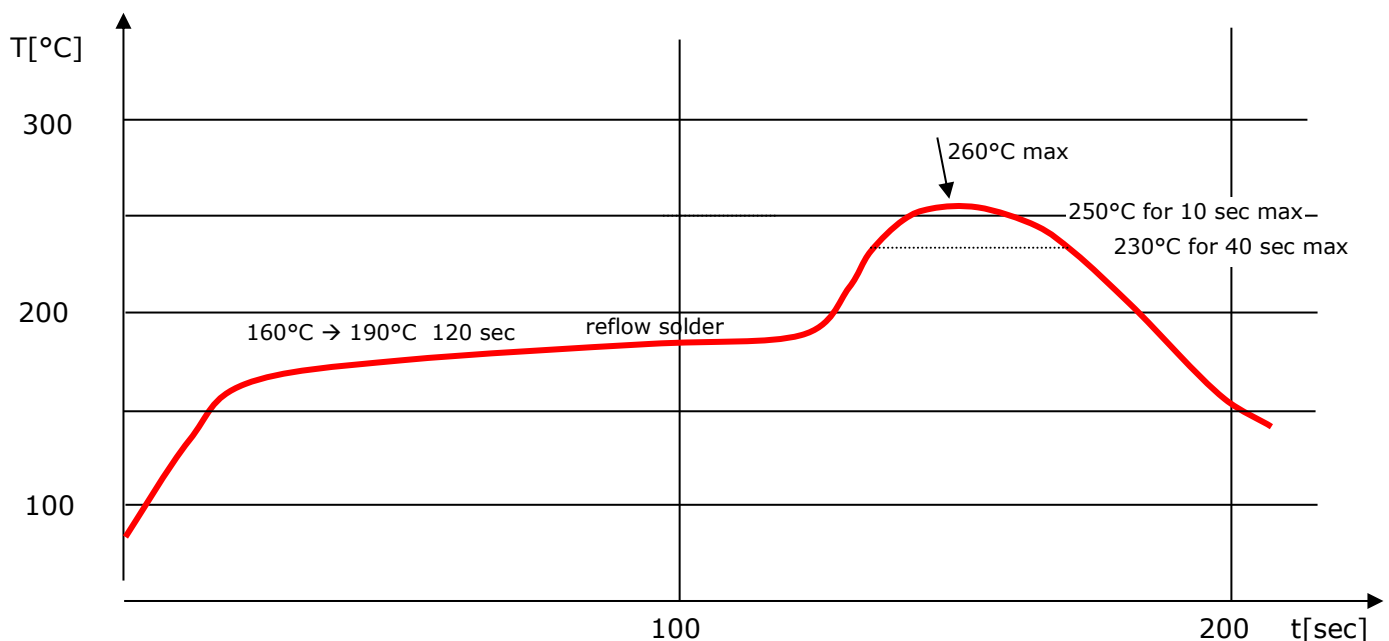
Cu: 53.5..56.5%

Ni : 16.5..19.5%

Zn : 24..30%

thickness :0.2mm

### 13 RECOMMENDED SOLDERING REFLOW PROFILE



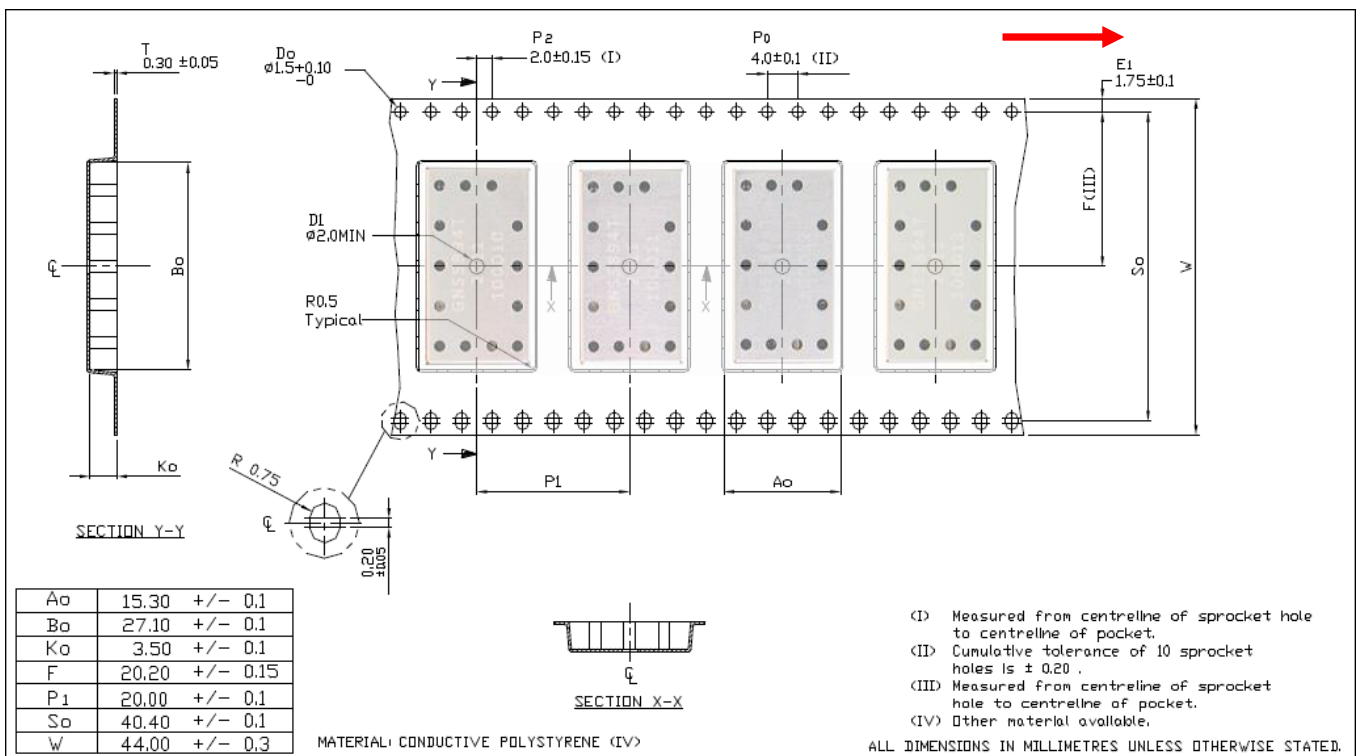
#### Notes:

1. GNS 5851 should be soldered in upright soldering position. In case of head-over soldering, please prevent shielding / GNS 5851 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

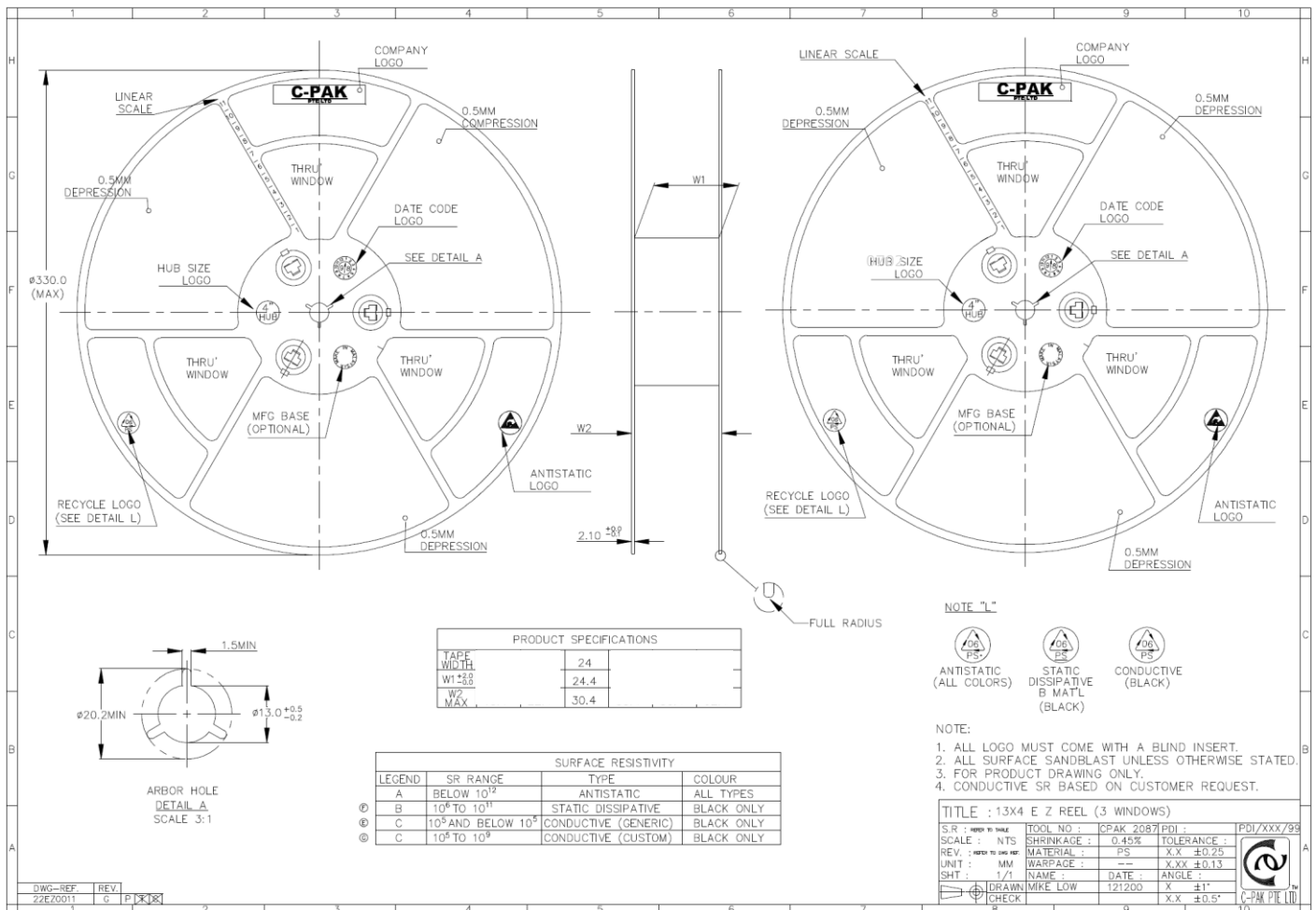
6. This device is not applicable for solder iron process

### 14 TAPE INFORMATION

Component orientation:  
arrow shows open-end  
direction of tape



### 15 REEL INFORMATION



no. of devices : 500 pcs / reel

### 16 ORDERING INFORMATION

Ordering information			
Type	Part#	Laser marking	Description
GNS 5851 AIS module	4037735100718	GNS 5851 <yy cw> <serial#>	AIS module

## 17 ENVIRONMENTAL INFORMATION

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

### 17.1 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 <sup>2</sup> , 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 GNS 5851 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".



### 18 DOCUMENT REVISION HISTORY

Version	Revision	Date	Author	comment
V0.9	Preliminary	2021-08-30	C. Diehl	First version based on existing production hardware

#### Document status

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

### 19 DISCLAIMER

THE USE OF THE DATA RECEIVED WITH GNS 5851 MODULE IS STRICTLY LIMITED TO PERSONAL ENTHUSIAST ACTIVITIES (I.E. FOR ENTERTAINMENT PURPOSES), WHICH SPECIFICALLY EXCLUDE ANY ACTIVITIES THAT MIGHT ENDANGER YOURSELF OR THE LIVES OF OTHERS.

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