

LEADTEK GPS MODULE LR9023 Specifications Sheet



Features:

- ▶ Mediatek MT3329
- ▶ Compact module size for easy integration :
- ▶ **11.4 x 10 x 2.0 mm**-165dBm
- ▶ USBV2.0 Full Speed Compliant interface
UART interface

Revision History:			
Revision	Release Date	Issuer	Change Description
1.0	2008/11/3	J. Lee	Preliminary draft
1.1	2008/11/12	J. Lee	Re-define the pin assignment and confirm the dimension
1.2	2008/11/19	J. Lee	Re-organize the structure & revise specs
1.3	2008/12/22	J. Lee	Re-define the SW baud rate/storage temperature/Power C. & Add mechanical drawing
1.4	2008/12/30	J. Lee	Modify the USB power supply and power consumption & add mode definition
1.5	2008/12/31	J. Lee	Add electrical specification/reference design and revise the DGPS description
1.6	2009/1/9	J. Lee	Add the electrical specification & reference design and reset in order
1.7	2009/1/16	J. Lee	Revise the description of TTFF measurement & the searching channels, and add the module pic
1.8	2009/3/5	J. Lee	Add packing/reflow profile/storage & baking condition and re-organize the wording
1.9	2009/6/3	J. Lee	Position accuracy revised

1. Introduction

The Leadtek LR9023 module is a high sensitivity, low power and very compact Surface Mount Device (SMD), and it supports signal processing of L1 band signals such as GPS C/A and SBAS (including WAAS, EGNOS, and MSAS). This 22-channel global positioning system (GPS) receiver is designed for a broad spectrum of OEM applications and is based on the fast and deep GPS signal search capabilities of Mediatek MT3329 architecture, consuming . Leadtek LR9023 is designed to allow quick and easy integration into GPS-related applications, especially for compact size devices, such as:

- ▶ PDA, Pocket PC and other computing devices
- ▶ Fleet Management / Asset Tracking
- ▶ AVL and Location-Based Services
- ▶ Hand-held Device for Personal Positioning and Navigation

1.1. Features

Hardware and Software

- ▶ 22 tracking/ 66 acquisition channels
- ▶ Based on the high performance features of the Mediatek MT3329 chipset.
- ▶ Advanced DBA technology to achieve -165dBm tracking
- ▶ Compact module size for easy integration: 11.4x10.0x2.0 mm.
- ▶ SMT pads allow for fully automatic assembly processes equipment and reflow soldering
- ▶ Multi-path Mitigation Hardware
- ▶ Built-in antenna detection and provided GPS Status information
- ▶ Built-in LDO, regulators & USB interface to decrease extra-BOM cost
- ▶ Up to 10Hz update rate
- ▶ Embedded DC/DC circuitry to prolong battery life
- ▶ AGPS supported

Performance

- ▶ Cold/Warm/Hot Start Time: 35 / 34 / 1.5 sec.
- ▶ Reacquisition < 1 sec

- ▶ RF Metal Shield for best performance in noisy environments
- ▶ Enhanced Navigation Performance
- ▶ Improved Jamming Mitigation

Interface

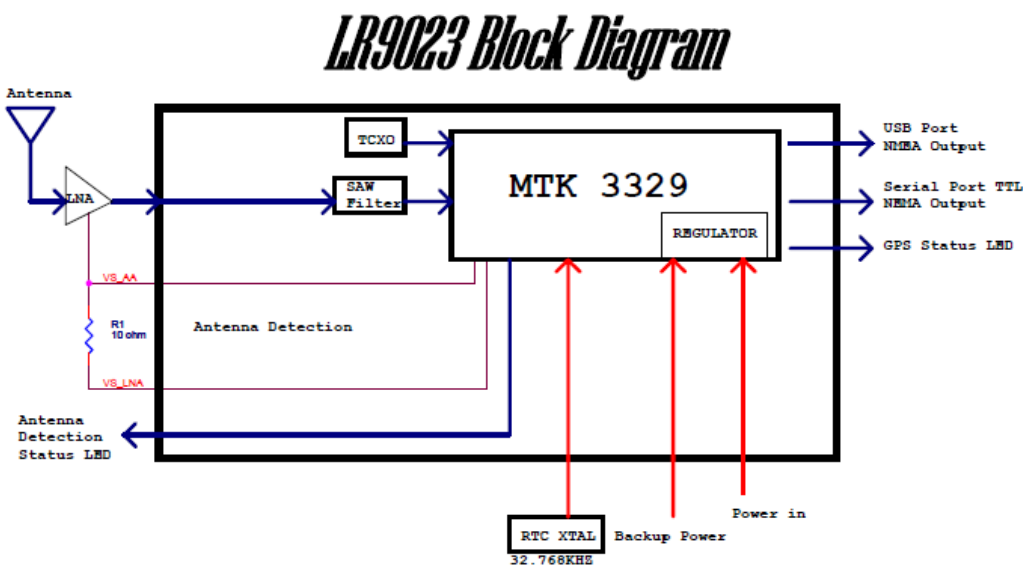
- ▶ TTL level serial port and USBV2.0 full speed compliant interface
- ▶ UART interface
- ▶ Protocol: NMEA
- ▶ Baud Rate: 9600 bps(Default)

Advantages

- ▶ Ideal for compact size devices
- ▶ Data / Power / RF through surface mount pads
- ▶ Cost saving through elimination of RF and board to board digital connectors
- ▶ Flexible and cost effective hardware design for different application requirements
- ▶ Secure SMD PCB mounting method

2. Technical specifications

2.1. Module architecture



Component	Part number	Manufacturer
RTC X'tal 32.768KHz \pm 20ppm	FC-135/MC-146	EPSON
	CC7V	Micro Crystal
	ST-4115A	Hertz

Table 2-1 Recommended RTC X'tal list

2.2. Software

The firmware used on Leadtek 9023 for Mediatek receivers and its features include:

- ▶ High configurability
- ▶ Up to 10 Hz position update rate
- ▶ Supports use of satellite-based augmentation systems including WAAS, EGNOS, MSAS
- ▶ NMEA 0183 standard V3.01 and backward compliance and support 219 different Datum
- ▶ Default configuration is as follows:

Item	Description
Core of firmware	MTK version AXN_1.1
Baud rate	9600 bps
Code type	NMEA-0183 ASCII
Datum	WGS-84
Protocol message	GGA(1s), GSA(5s), GSV(5s), RMC(1s),VTG(1s)
Output frequency	1 Hz

2.3. Electrical specification

2.3.1 Absolute maximum ratings

Parameter	Symbol	Min	Max	Units
Power supply voltage	VCC-IN	-0.3	4.3	V
Backup battery voltage	RTC-VDD-INPUT	-0.3	4.3	V
USB supply voltage	USB-VDD	-0.3	3.6	V

2.3.2 Operation Conditions

Parameter	Symbol	Min	Typ	Max	Units
Power Supply					
Power supply voltage	VCC-IN	3	3.3	4.3	V
Backup battery voltage	RTC-VDD-INPUT	2	2.8	4.3	V
USB supply voltage	USB-VDD	3	3.3	3.6	V
UART and I/O					
Input Low Voltage		-0.3		0.8	V
Input High Voltage		2		3.6	V
Output Low Voltage		-0.3		0.4	V
Output High Voltage		2.4		2.8	V
Total Input Gain					
		20		50	dB

2.3.3 Power Consumption

Status	Power Consumption
Acquisitioning	40mA
Tracking	33mA
Power save mode	29.47mA
Periodic mode	6~33mA(ON/OFF)

Mode	TCXO	PLL	DSP	Power (mW)	To fix latency (sec)	Note
Fully Active	Active	Active	Active	132	0	Fully Active
Power Save	Active	Active	Periodic On/Off	98	0	Collect all Almanac then auto changes to Power save mode
Periodic	Active	Periodic On/Off	Periodic On/Off	20~109	0	Periodic fix mode Fix rate 1-0.02Hz
Power off	Off	Off	Off	0	1	Turned off

Table 2-2 Mode definition

2.4. Recommended GPS Antenna Specification

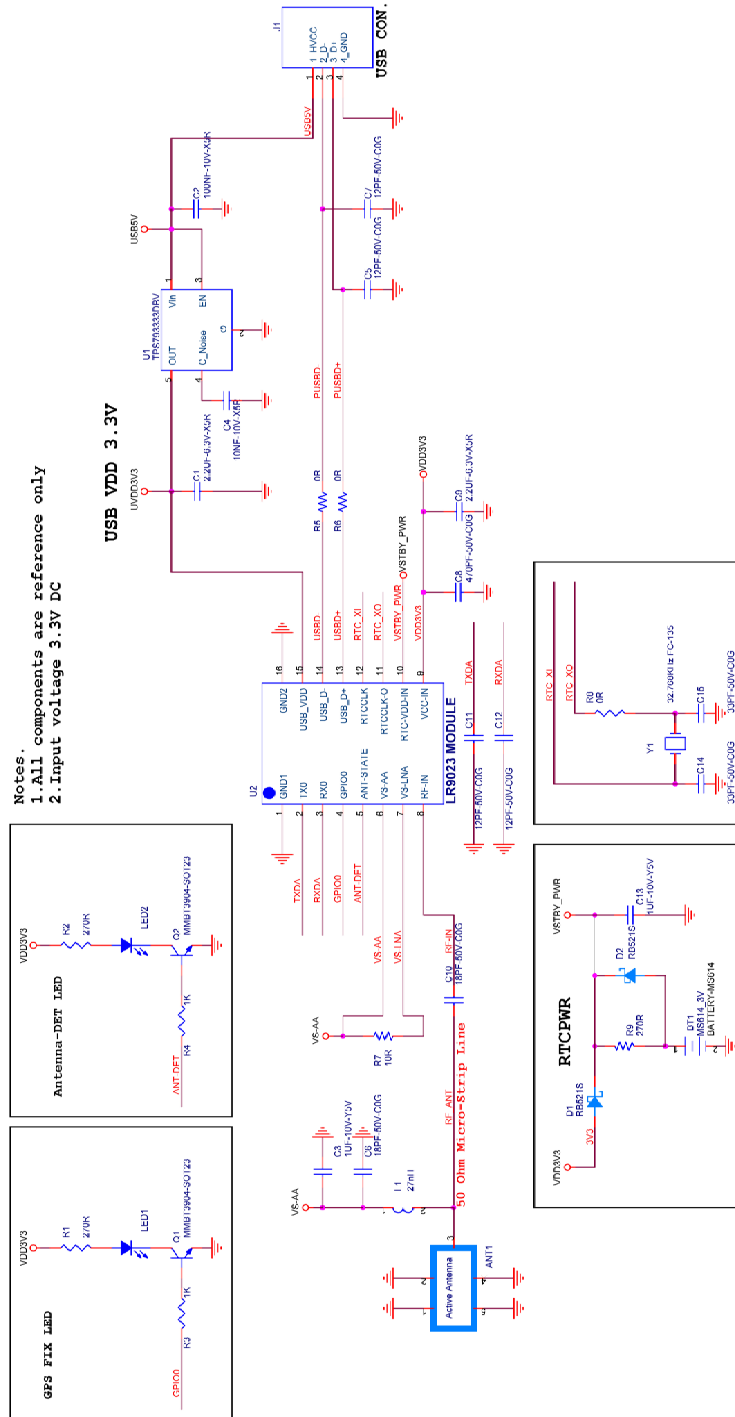
This LR9023 receiver is designed for use with active antenna.

Parameter	Specification
Antenna Type	Right-hand circular polarized active patch antenna
Frequency Range	1575.42 ± 1.023 MHz
Impedance	50Ohm
LNA	2 stage LNA, gain ≥ 20dB and ≤ 50dB

2.5. Environmental Specification

Item	Description
Operating temperature rang	-40 deg. C to +85 deg. C
Storage temperature range	-40 deg. C to +85 deg. C
Altitude	18,000 meters (60,000 feet) max.
Velocity	515 meters/second (1000 knots) max.
Jerk	20 meters/second ³ , max.
Acceleration	4g, max.

2.6. Reference Design



3. Performance Characteristics

3.1. Position and velocity accuracy

Accuracy	Position	3 meters, 2D RMS 2.5m (DGPS)
	Velocity	0.1 meters/second
	Time	1 microsecond synchronized to GPS time

3.2. Dynamic constrains

Dynamic Conditions	Altitude	18,000 meters (60,000 feet) max.
	Velocity	515 meters/second (1000 knots) max.
	Acceleration	4g, max.
	Jerk	20 meters/second ³ , max.

3.3. Acquisition time TTFF¹

Mode	Leadtek 9023 GPS Module
Hot Start (valid almanac, position, time & ephemeris)	1.5 s
Warm Start (valid almanac, position, & time)	34 s
Cold Start (valid almanac)	35 s
Timing Accuracy	100 ns

Note 1: The mean value of 100-time tests at open Sky and Stationary Environments.

3.4. Sensitivity

Parameter	Description
Tracking Sensitivity	-165 dBm
Acquisition Sensitivity	-148 dBm

3.5. Battery backup (SRAM/RTC backup)

During 'Powered down' condition, the SRAM and RTC (Real Time Clock) may be kept operation by supplying power from VBATT. The Leadtek 9023 GPS module can accept slow VBATT supply rise time due to an on-board voltage detector.

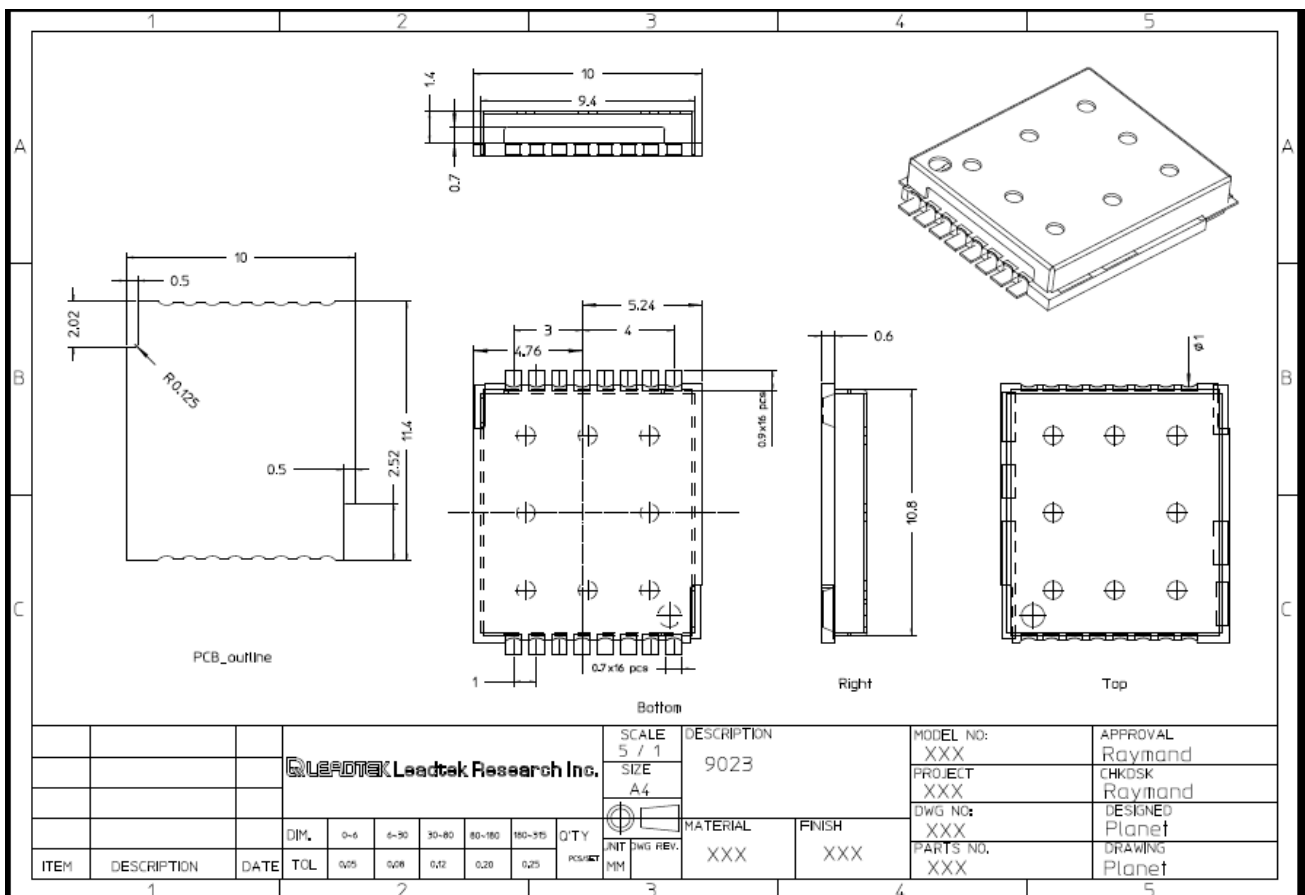
4. Mechanical specification

4.1. Mechanical specification

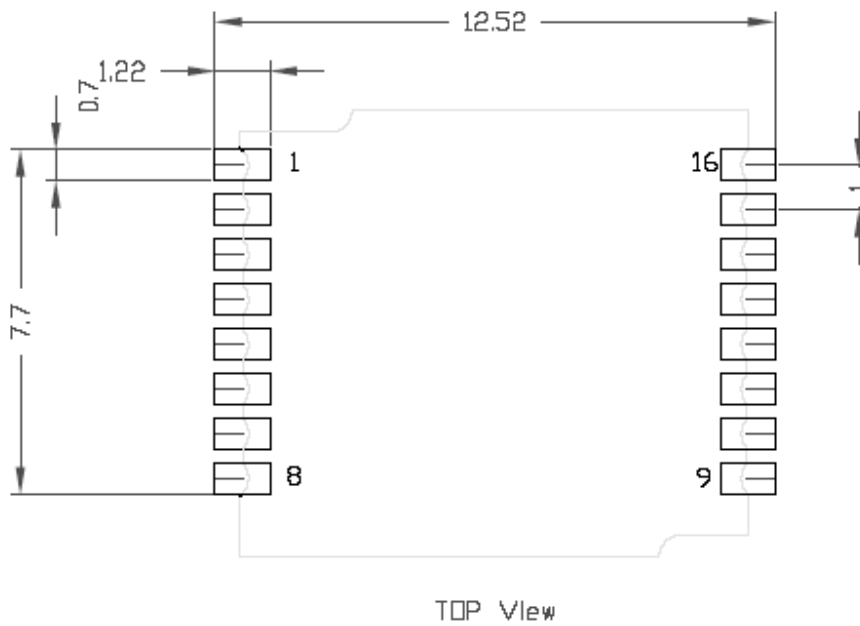
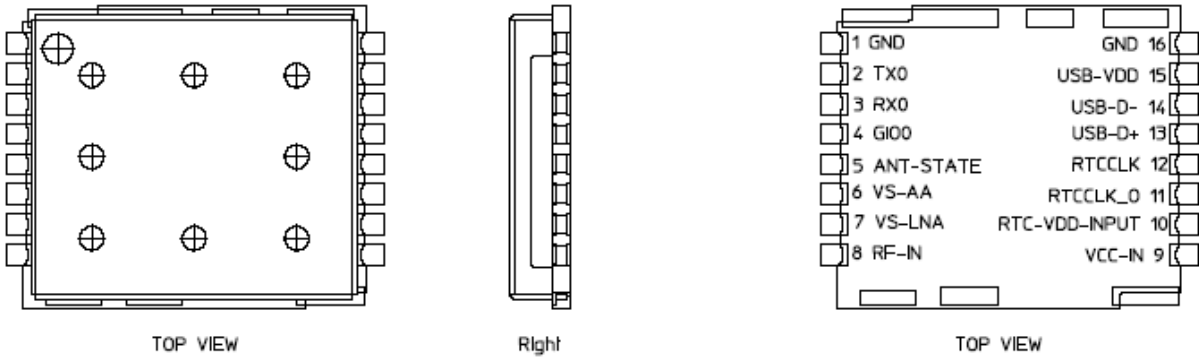
The Physical dimensions of the Leadtek 9023 GPS Module are as follow:

Items	Description
Length	11.4 ± 0.3 mm
Width	10.0 ± 0.3 mm
Height	2.0 ± 0.3 mm
Weight	0.4g

4.2. Mechanical drawing



4.3. Module View



PCB Footprint

4.4. Module picture



4.5. Pin Assignment

Pin	Pin Name	Pin Definition
1	GND	Ground
2	TX0	TTL UART Port 0 output
3	RX0	TTL UART Port 0 input
4	GIO0	GPS Status LED
5	ANT-STATE	Antenna Status LED
6	VS-AA	Antenna signal detection
7	VS-LNA	Antenna signal detection
8	RF-IN	RF signal input
9	VCC-IN	3.3V DC supply input
10	RTC-VDD-INPUT	RTC Power input
11	RTCCLK_O	RTC clock output
12	RTCCLK	RTC clock input
13	USB-D+	USB differential Signal +
14	USB-D-	USB differential Signal -
15	USB-VDD	3.3V DC supply input
16	GND	Ground

5. Software interface

5.1. NMEA output messages

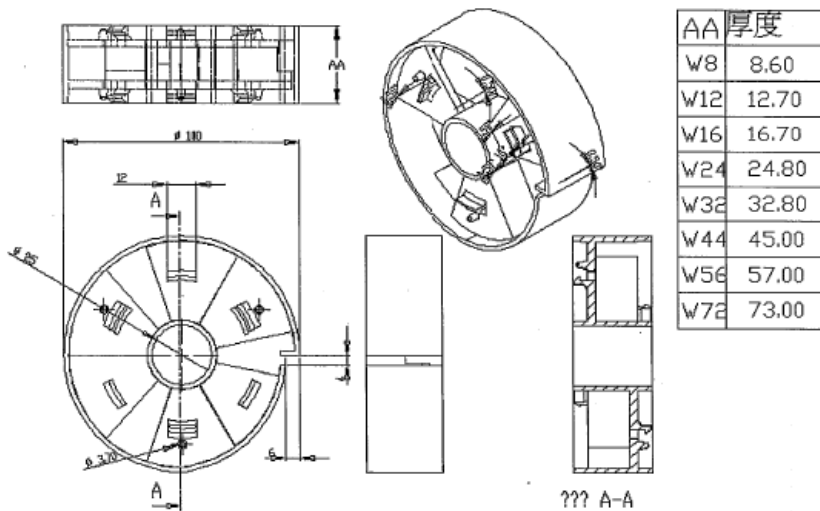
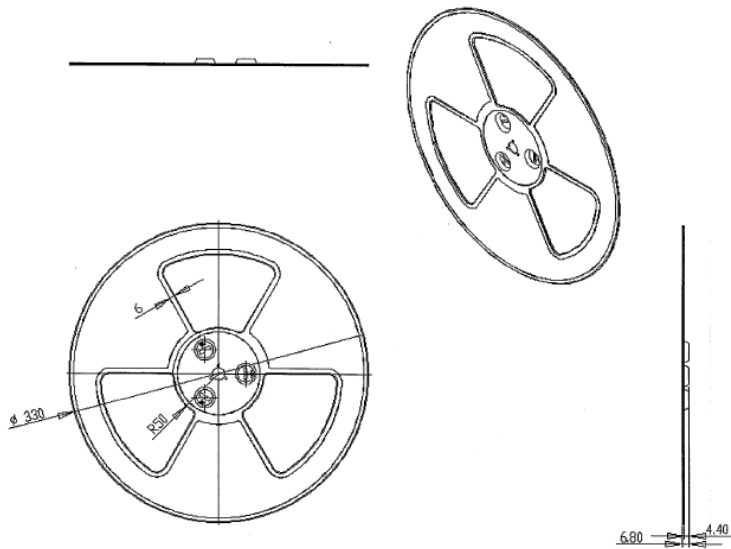
The output NMEA (0183 v3.01) messages for the receiver are listed in Table 5-1.

Option	Description
GGA	Time, position, and fix related data for a GPS receiver.
GLL	Latitude and longitude of present position, time of position fix and status.
GSA	GPS receiver operating mode, satellites used in the position solution, and DOP values.
GSV	The number of GPS satellites in view satellite ID numbers, elevation, azimuth, and SNR values.
RMC	Time, date, position, course and speed data provided by the GPS receiver.
VTG	The actual course and speed relative to the ground.

Table 5-1 NMEA-0183 Output messages

6. Automated manufacturing components

6.1. Reel and tapping specifications

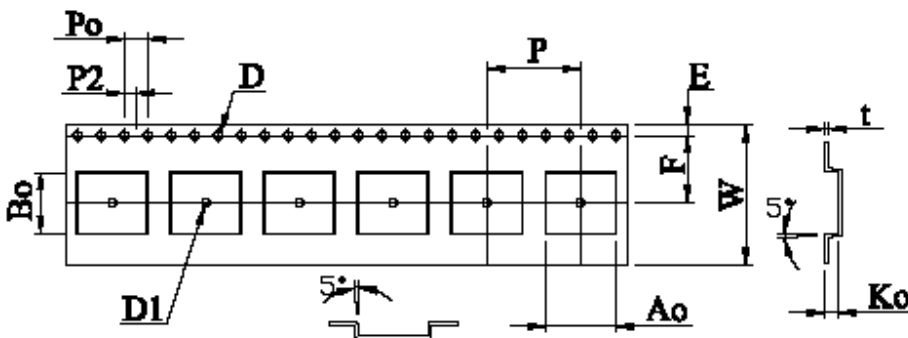


6.2. Polystyrene Alloy Taping Specifications

- ▶ 10 Sprocket hole pitch cumulate tolerance ± 0.2 mm
- ▶ Carrier camber is within 1mm in 100mm.
- ▶ Material: black conductive polystyrene alloy.
- ▶ Ao and Bo measured on plane 0.3mm above the bottom of the packet.
- ▶ Ko measured from a plane on the inside bottom of the packet to the top surface of the carrier.
- ▶ Packet position relative to sprocket hole measured as true position of packet.
- ▶ 13" 1500pcs/25M 1:3

6.3. Polystyrene Alloy Taping Drawing

SPEC NO: 9023



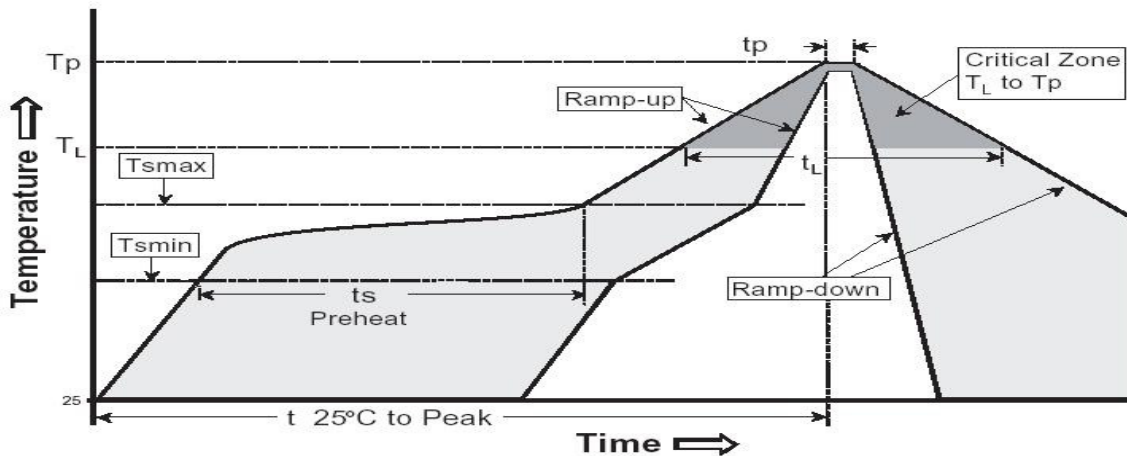
RATIO 1 : 1

ITEM	SPEC
W	24.0 ^{+0.30} _{-0.30}
Ao	11.8 ^{+0.10} _{-0.10}
Bo	10.4 ^{+0.10} _{-0.10}
Ko	2.30 ^{+0.10} _{-0.10}
P	16.0 ^{+0.10} _{-0.10}
F	11.5 ^{+0.10} _{-0.10}
E	1.75 ^{+0.10} _{-0.10}
D	1.50 ^{+0.10} _{-0.10}
D1	1.50 ^{+0.10} _{-0.10}
Po	4.00 ^{+0.10} _{-0.10}
P2	2.00 ^{+0.10} _{-0.10}
t	0.50 ^{+0.05} _{-0.05}

7. RoHS soldering profile

7.1. Reflow profile

High quality, low defect soldering requires identifying the optimum temperature profile for reflowing the solder paste. To have the correct profile assures components, boards, and solder joints are not damaged and reliable solder connection is achievable. Profiles are essential for establishing and maintaining processes. You must be able to repeat the profile to achieve process consistency. The heating and cooling rise rates must be compatible with the solder paste and components. The amount of time that the assembly is exposed to certain temperatures must first be defined and then maintained.



Average ramp-up rate	3°C/second max.
Preheat (T_{smax} – T_{smin}, t_s)	150~200°C ; 60~180seconds
Time maintained above (T_L, t_L)	217°C ; 60~150seconds
Peak Temperature (T_p)	255~260°C ; 10~20seconds
Ramp-down rate	6°C/second max.
Time 25°C to Peak Temperature	8 minutes max.
Maximum number of reflow cycles	≤ 3

Note:

This module has to be upside (the side with the shielding) mounted while reflowing.

7.2. Storage & baking condition

1. Calculated shelf life in sealed bag: 6 months at $<40^{\circ}\text{C}$ and $<90\%$ relative humidity(RH).
2. After bag is opened, devices that will be subjected to reflow soldering or other high temperature process must be:
 - a. Mounted within: 24 hours of factory conditions $\leq 30^{\circ}\text{C}$ /60% RH, or
 - b. Stored at $<10\%$ RH under the protection against humidity and static electricity
3. Devices require bake before mounting, if:
 - a. Humidity indicator Card is $>60\%$ when read at $23\pm 5^{\circ}\text{C}$
 - b. 2a or 2b not met
4. If baking is required, devices may be baked for 24 hours at $125\pm 5^{\circ}\text{C}$

Note: if device containers cannot be subjected to high temperature or if shorter bake times are desired, reference IPC/JEDEC J-STD-020 for bake procedure