

R1371T

SPECIFICATION

Contents

- 1.功能说明 3
 - 1.1. 概述 3
 - 1.2. 框图 3
 - 1.3. 特征..... 4
 - 1.4. 系统启动..... 4
 - 1.5. 安装..... 5
 - 安装信息（坐标系） 5
 - 数据输出 5
- 2.机械规格 6
 - 2.1. 外形尺寸 6
 - 2.2. 规格..... 6
- 3.接口规范 7
 - 3.1. 引脚配置 7
 - 3.2. 引脚定义..... 7
- 4.电气规范..... 8
- 5.性能规格..... 9
- 6.协议 10
 - 6.1. 系统信息 10
 - 6.2. 整数输出格式 10
 - 6.3. 输入命令格式 12
- 7.环境规范 15
- 8.回流温度指南 16
- 9.包装规格 17
 - 9.1. 托盘尺寸..... 17
 - 9.2. 盒装 18
- 10.符合RoHS标准..... 19
- 11.处理预防措施 20

数字清单

Figure 1: Functional diagram.....	3
Figure 2: CruizCore® R1371T coordinates system	5
Figure 3: Dimensions.....	6
Figure 4: Pin configuration of connectors.....	7
Figure 5: CruizCore® R1371T data packet format.....	10
Figure 6: Temperature conditions at reflow	16
Figure 7 : Packing Tray	17

表格列表

Table 1: Mechanical specification.....	6
Table 2: Pin definition	7
Table 3: Absolute maximum ratings.....	8
Table 4: CruizCore® R1371T electrical characteristics.....	8
Table 5: CruizCore® R1371T performance characteristics.....	9
Table 6: CruizCore® R1371T data fields description.	11
Table 7: Data packet parsing example.	11
Table 8: Command Summary	12
Table 9: Baud rate and maximum output rate.	12
Table 10: Default settings.	13
Table 11: Command examples	14
Table 12: Environment and mechanical test.	15
Table 13: Judgment criteria of environment and mechanical test.	15

1. 功能说明

1.1. 背景

CruizCore®R1371T 是一款数字陀螺仪和加速度计，用于测量动态条件下的角速率，航向角（也称为方向或偏航）和加速度。它是一种高度紧凑，轻便且完全独立的设备。在内部，R1371T包含MEMS陀螺仪，3轴加速度计，内部稳压器，信号处理电路，AD转换器和运行我们专利纠错算法的RISC微处理器。CruizCore®R1371T使用自适应降阶卡尔曼滤波器来减少影响此类传感器的误差（即偏置漂移，比例因子，不对称性），因此它可以产生非常精确的稳定角速率和航向角。启动时间小于1秒，用于计算偏置参数；此后不需要进一步校准。R1371T是用于导航应用的最佳单轴速率测量解决方案。

1.2. 框图

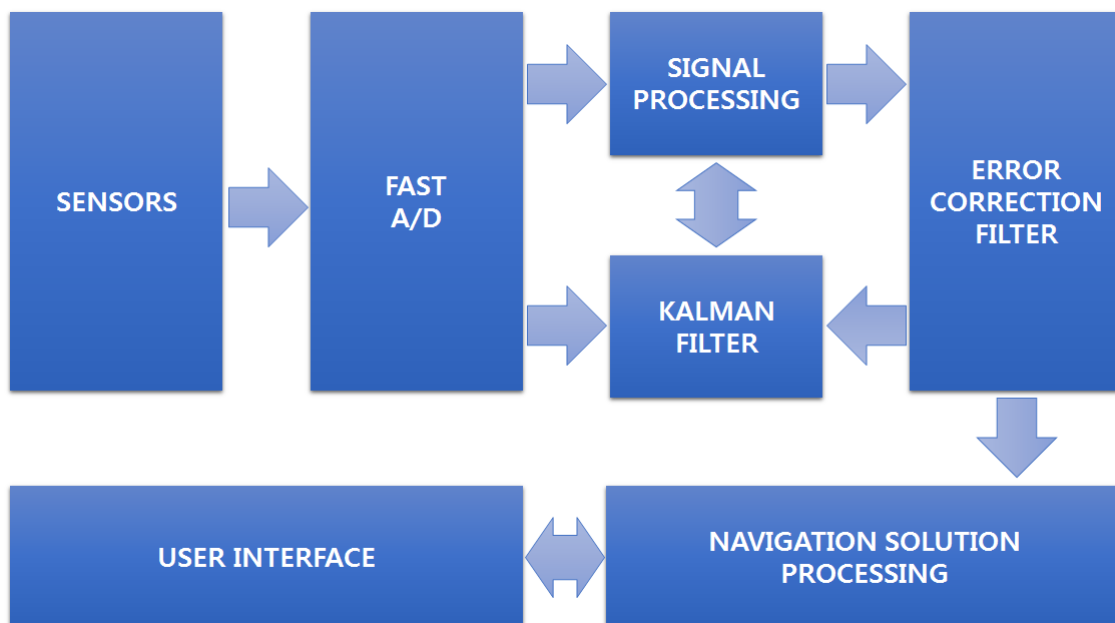
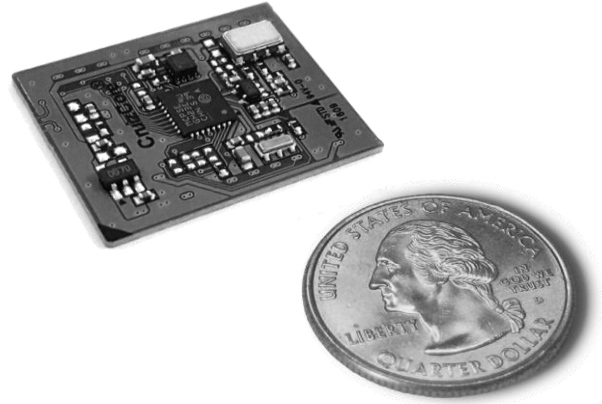


Figure 1: Functional diagram.

1.3. 特征

- UART输出 (SPI, I2C可选)
- 低功耗
- 紧凑的包装
- 定制带宽 (可选)
- 快速启动
- 完全独立
- 速率输出
- 角度输出
- 3轴加速输出



1.4. 系统启动

CruizCore®R1371T 的启动时间不到一秒。它内部补偿由于温度变化引起的误差。但是，在打开设备电源后不久，温度突然变化会导致静态速率错误。如果预计会出现这样的温度变化，我们建议在启动后将陀螺仪静止5秒钟。

1.5. 安装

安装信息 (坐标系)

CruizCore®R1371T 坐标系的敏感轴垂直于设备较平坦的区域 (见图2), 因此当其敏感轴沿顺时针方向旋转时, 陀螺仪将显示正角速率 (和角度增量) (其他) 坐标系可作为选项提供)。安装不正确会产生与比例因子误差具有相似效果的错位错误, 因此可以这样处理。如果此错误很明显, 我们建议使用单轴速率表重新计算比例因子。

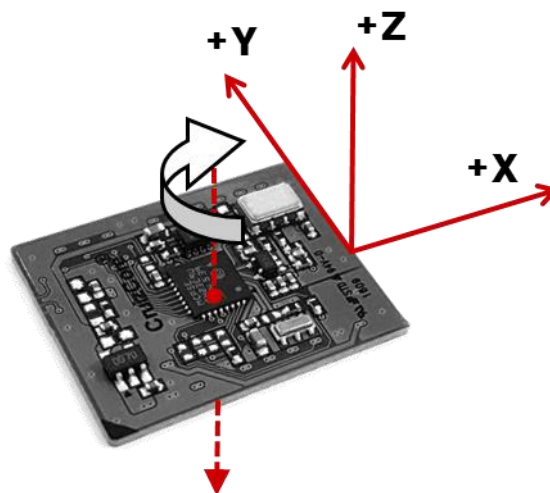


Figure 2: CruizCore® R1371T coordinates system

Data Output

The UART serial settings are 115200, 8, 1, N with no handshaking.

2. 机械规格

2.1. Dimensions

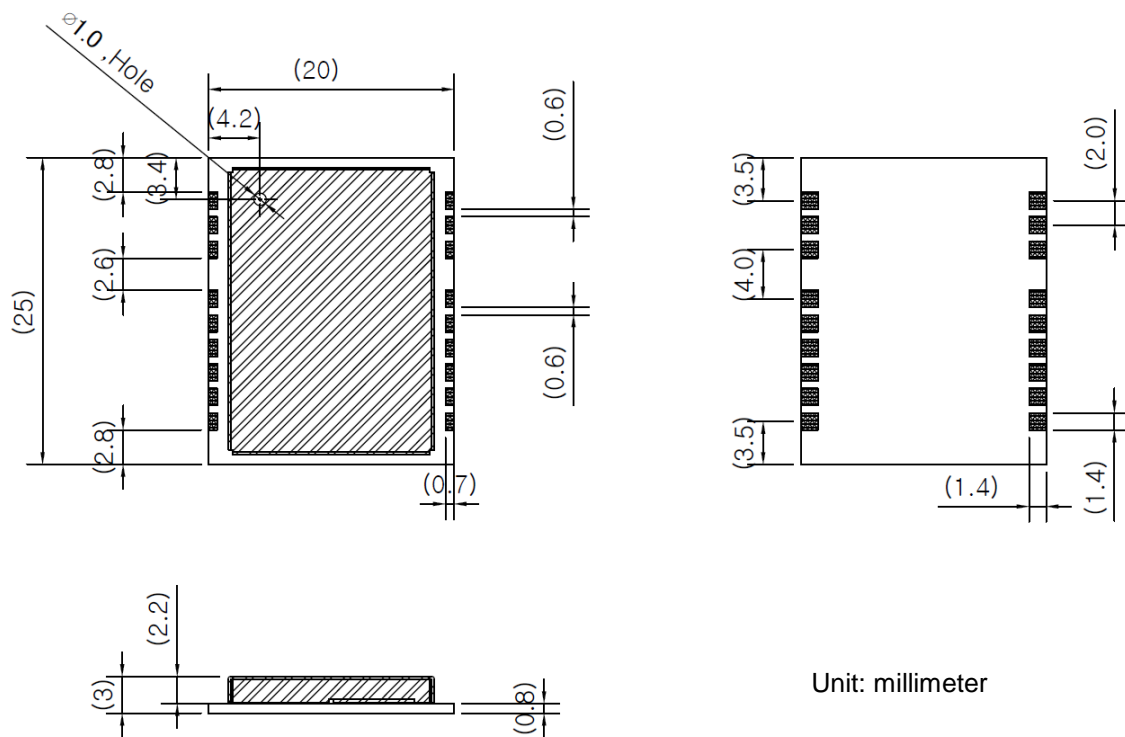


Figure 3: Dimensions

2.2. 规格

Table 1: Mechanical specification

Parameter	Specification	Tolerance	Comment
Length	25.0	±0.2	Unit: millimeter.
Width	20.0	±0.2	
Height	3.0	-1.0	
Weight	3.0	-1.5	Unit: gram

3. 接口规范

3.1. Pin Configuration

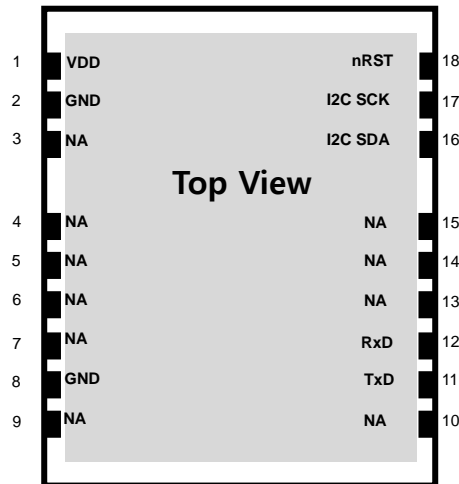


Figure 4: Pin configuration of connectors

3.2. Pin Definition

Table 2: Pin definition

Pin No.	Pin Name	I/O	Description
1	VDD	-	Main power (3.2V ~ 5.5VDC)
2	GND	-	Power ground
8	GND	-	Power ground
11	TxD	O	UART transmit data
12	RxD	I	UART receive data
16	I2C SDA	I/O	I2C data Line (optional)
17	I2C SCK	I/O	I2C Clock Line (optional)
18	nRST	I	System reset input
-	NA	-	Not available (leave open)

4. 电气规范

Table 3: Absolute maximum ratings

Parameter	Symbol	Value	Unit	Note
Power supply voltage	VCC	-0.3 ~ 6.5	V	GND=0V
nRST Input voltage	V_nRST	-0.3 ~ 3.3	V	VCC=3.3V GND=0V
Port Input voltage	V_IO	-0.3 ~ 3.3	V	VCC=3.3V GND=0V
Operating temperature	TOPR	-20 ~ +80	°C	
Storage temperature	TSTG	-40 ~ +85	°C	

Table 4: CruizCore® R1371T electrical characteristics

Parameter			Value			Unit
			Min.	Typ.	Max.	
POWER	INPUT VOLTAGE	OPERATING	3.2		5.5	V
		RECOMMENDED		3.3		V
	CURRENT	@ 3.3 V		13		mA
	POWER	@ 3.3 V		43		mW
I/O	Pins for communication	INPUT "L"	-0.3		0.8	V
		INPUT "H"	2.2		3.3	V
		OUTPUT "L" ¹			0.4	V
		OUTPUT "H" ²	2.4			V
	nRST ³	INPUT "L"			0.6	V
		INPUT "H"	2.4			V

* Data voltage levels can vary slightly due to internal load changes.

1. VCC = 3.3V, the maximum total current $I_{OL(max)}$ = 5mA
2. VCC = 3.3V, the maximum total current $I_{OH(max)}$ = 5mA
3. Use open collector logic when using the nRST function.

5. 性能规格

Table 5: CruizCore® R1371T performance characteristics

参数		Value			Unit	
		Min.	Typ.	Max.		
GENERAL	带宽	RATE	10		50	Hz
	启动时间	快速启动		0.5		sec
		FULL ALIGNMENT ¹			5	
角速率	输入范围				± 200	deg/sec
	比例因子误差		0.5	1		%
	零偏漂移		< 10	50		deg/hr
相对角度	RESOLUTION		0.01			deg
	PROPORTIONAL ERROR ²			1		%
	漂移误差			60		deg/hr
ACCELERATION	测量范围		± 2			G
DATA RATE	ADJUSTABLE ³		100			Hz

* The system must be installed in the correct position.

** @TOPR=+25°C, VCC=3.3V.

1. Full alignment: Total time that takes for full bias error calibration and temperature compensation. It is the worst case on condition that the temperature goes up suddenly without temperature compensation.

2. Guaranteed only under conditions: full alignment, steady-state room temperature, under 200 deg/sec angular rate.

3. Other data rate available as option.

6. Protocol

The CruizCore® R1371T provides rate, angle and acceleration outputs. The angle output is a relative and can be affected by several conditions such as sampling rate variations, bandwidth limitation, dynamic range, alignment, and device mounting.

6.1. System information

When the CruizCore® R1371T is powered up, it transmits the system information. For example:

```
%CruizCore R13T rX. X
%SW Ver X. XX-DF
%(c) 2002-2016 MicroInfinity Co., Ltd.
```

The system information output can be changed without notice.

6.2. Integer output format

Following the system information the CruizCore® R1371T starts transmitting the sensor data packages. The CruizCore® R1371T provides rate, angle and acceleration outputs. The output format is shown in Figure 5 and is described in Table 6. The integer output consists on a 2 byte header, a 1byte index, a 1byte reserved, a 10 byte data section and 1 byte checksum. The output in this format is given in hundredths of degrees, i.e. a 0.1 degree angle will be displayed as 10 (or 0x0A HEX). The output voltage level of the serial port is 3.0 V. An example of the data packet sample is provided in Table 7.

HEADER		DATA										Check sum			
		Index	ANGLE		RATE		X-axis Acceleration		Y-Axis Acceleration		Z-Axis Acceleration		Reser ved		
0xAA	0x00														
2byte		1byte	2byte		2byte		2byte		2byte		2byte		1byte	1byte	

Figure 5: CruizCore® R1371T data packet format

Table 6: CruizCore® R1371T data fields description.

OUTPUT DATA	BYTE	COMMENTS
HEADER	1-2	Hex value is: 0xAA00
INDEX	3	0x00 ~ 0xFF
ANGLE ¹	4-5	Provided in hundredths of deg
RATE ¹	6-7	Provided in hundredths of deg/sec
X-axis Acceleration ¹	8-9	Provided in 1mg resolution
Y-axis Acceleration ¹	10-11	Provided in 1mg resolution
Z-axis Acceleration ¹	12-13	Provided in 1mg resolution
Reserved	14	
CHECKSUM ^{1,2}	15	Is equal to: index + angle(LSB) + angle(MSB) + rate(LSB) + rate(MSB) + Xacc(LSB) + Xacc(MSB) + Yacc(LSB) + Yacc(MSB) + Zacc(LSB) + Zacc(MSB) + reserved

1. First byte is the least significant.

2. CHECKSUM is 1 byte and the overflowed more than 1 byte is ignored.

Table 7: Data packet parsing example.

Parameter	Comments/Calculations
Data packet	0xAA00E4C80070003400210002010074
Index	Index(hex) = 0xE4 = 228
Angle output	Angle (hundredths deg) = 0xC800 (hex) = 200 Angle (deg) = 200/100 = 2.00
Rate output	Rate (hundredths deg/sec) = 0x7000 (hex) = 112 Rate (deg/sec) = 112/100 = 1.12
Acceleration output	Acceleration (1mg resolution) = 0x0201 (hex) = 258 Acceleration (G) = 258 * 1 = 258mg
Checksum	CHEKSUM (hex) = 0xE4+0xC8+0x00+0x70+0x00+0x34+0x00+0x21+ 0x00+0x02+0x01+0x00 = 0x74

6.3. Input Command Format

The CruizCore® R1371T can accept input commands, those are used to change the baud rate, data output rate. The input command sets all the parameters at once, if the user does not want to change a certain parameter; the field can be skipped by leaving the respective field empty, still the comma character must be included. The CruizCore® R1371T only recognizes the input commands summarized in Table 8, no blank or other characters can be used.

Table 8: Command Summary.

Field	Command	Separator	Example
INIT	\$MIA	COMMA (,)	\$MIA,
FORMAT	I	COMMA (,)	I,
BAUD RATE	B,BAUDRATE	COMMA (,)	B,115200,
OUTPUT RATE	R	COMMA (,)	R,100,
TYPE	D	COMMA (,)	D,
OUTPUT	Y	COMMA (,)	Y,
FLASH	Y	COMMA (,)	Y,
CHECKSUM	SUM of COMMAND	ASTERISK(*)	*C4
SOFTWARE RESET	\$MIB,RESET*87		

■ INIT Field

Command start identifier. Must be '\$MIA'.

■ FORMAT Field

The 'I' means integer data format. The floating point and ASCII formats are not available on R1371T.

■ BAUD RATE Field

The baud rate setting can be chosen from the following available options: 115200, 57600, 38400, 28800, 19200, 9600, and 4800. Notice that the baud rate is set before the data output rate, therefore a low baud rate can limit the maximum data output rate. For example, for 4800 baud rate the maximum data output rate is only 25Hz. Table 9 shows the maximum output rates for a given baud rate.

Table 9: Baud rate and maximum output rate.

BAUD RATE	115200	57600	38400	28800	19200	9600	4800
MAX OUTPUT RATE	100Hz	100Hz	100Hz	100Hz	100Hz	50Hz	25Hz

■ OUTPUT RATE Field

Data output rate setting. This command determines data output rate, the following are the valid rates: 100Hz, 50Hz, 25Hz, and 10Hz.

■ TYPE Field

Data type setting. The rate and angle are provided in 'Degree' (D) format. The 'Radian' (R) format is not available on R1371T.

■ OUTPUT Field

Output setting 'Y' means all the data will be provided, and 'N' means none of the data will be provided. However, the 'N' command is not available on R1371T. That means the data will be provided all the time.

■ FLASH Field

This command determines whether the setting is stored or not in flash memory. But in case of R1371T, the 'Y' command is only available. So the settings are always stored in the flash memory and they will remain even after powering down the unit.

■ CHECKSUM Field

This is the sum of character after '\$' and before '*', and it is represented in HEX value.

■ Software Reset

This command '\$MIB,RESET*87' resets the device. The reset command has its own identifier, which is different that the other available commands. Refer to 1.4. for other details about sensor initialization.

■ Default settings

Table 10 shows the factory default settings for the CruizCore® R1371T, and Table 11 presents some examples of valid commands.

Table 10: Default settings.

FIELD	DEFAULT SETTING
FORMAT	I : integer format
BAUD RATE	B,115200 : 115200bps
OUTPUT RATE	R,100 : 100Hz
TYPE	D : Degree
OUTPUT	Y : all the data valid

■ Example

Table 11: Command examples.

Ex 1.	SETTING	Integer, 115200bps, 100Hz, Degree, Output enabled, Flash saved
	COMMAND	\$MIA,I,B,115200,R,100,D,Y,Y*C4
Ex 2.	SETTING	Integer, 19200bps, 100Hz, Degree, Output enabled, Flash saved
	COMMAND	\$MIA,I,B,19200,R,100,D,Y,Y*97
Ex 3.	SETTING	50Hz (The other settings are maintained.)
	COMMAND	\$MIA,,,,R,50,,, *EE
Ex 4.	SETTING	100Hz (The other settings are maintained.)
	COMMAND	\$MIA,,,,R,100,,, *1A

7. Environmental Specification

Table 12: Environment and mechanical test.

No.	Items	Test condition	Test Criteria
1	High temperature storage	85°C x 120h	Refer to table 13
2	Low temperature Storage	-40°C x 72h	Refer to table 13
3	Temperature and Humidity cycling	25°C, 60%RH(4h) / 55°C, 95%RH(10h) / -30°C(2h) / 75°C(2h), 10cycles	Refer to table 13
4	Thermal shock	-40°C ↔ 85°C 1hour at each temperature, 10cycles	Refer to table 13
5	Drop	Free drop from 750mm height on a wooden board for 3 times	Refer to table 13
6	Vibration	10Hz to 55Hz amplitude 0.75mm, 55Hz to 500Hz acceleration 98m/s ² , 10Hz→500Hz→10Hz 15min/cycle, 6h(2h x 3directions)	Refer to table 13
7	ESD	R(330Ω) C(150pF), Contact discharge, 5times	Refer to table 13

* After each test, there should be no visible damage and the measured values shall be met Table 13.

Table 13: Judgment criteria of environment and mechanical test.

Items	Units	Judgment criteria
Angular error	degree	When CW 1 rev, 0±1.0deg. After CW 1 rev, CCW 1 rev, 0±1.0deg.
ESD	voltage	1kV (No deviations) 2kV (Self-recoverable deviations)

8. Reflow Temperature Guideline

Recommended temperature conditions at reflow is shown on the following Figure 6.

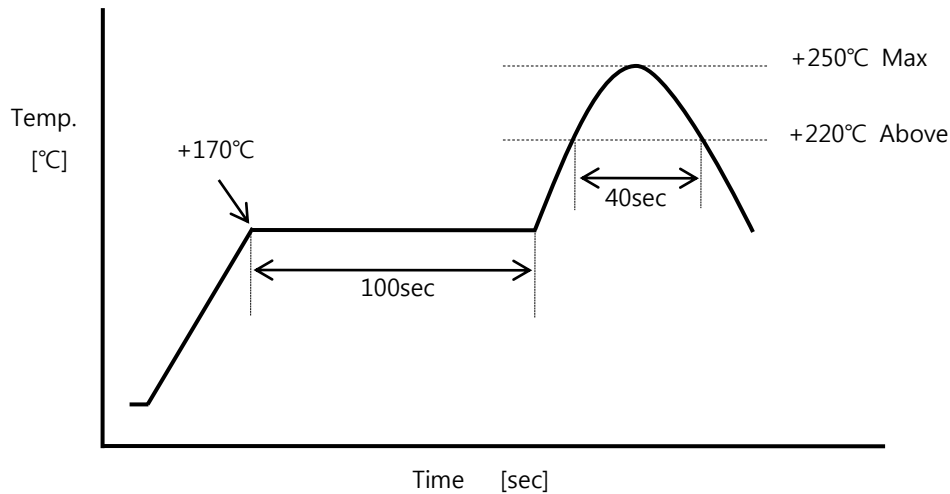


Figure 6: Temperature conditions at reflow

Pre-heating temperature: +170°C

Pre-heating time: 100sec

Heating temperature: +220°C

Heating time: 40sec

Peak temperature \leq +250°C

9. Packing Specification

9.1. Tray dimensions

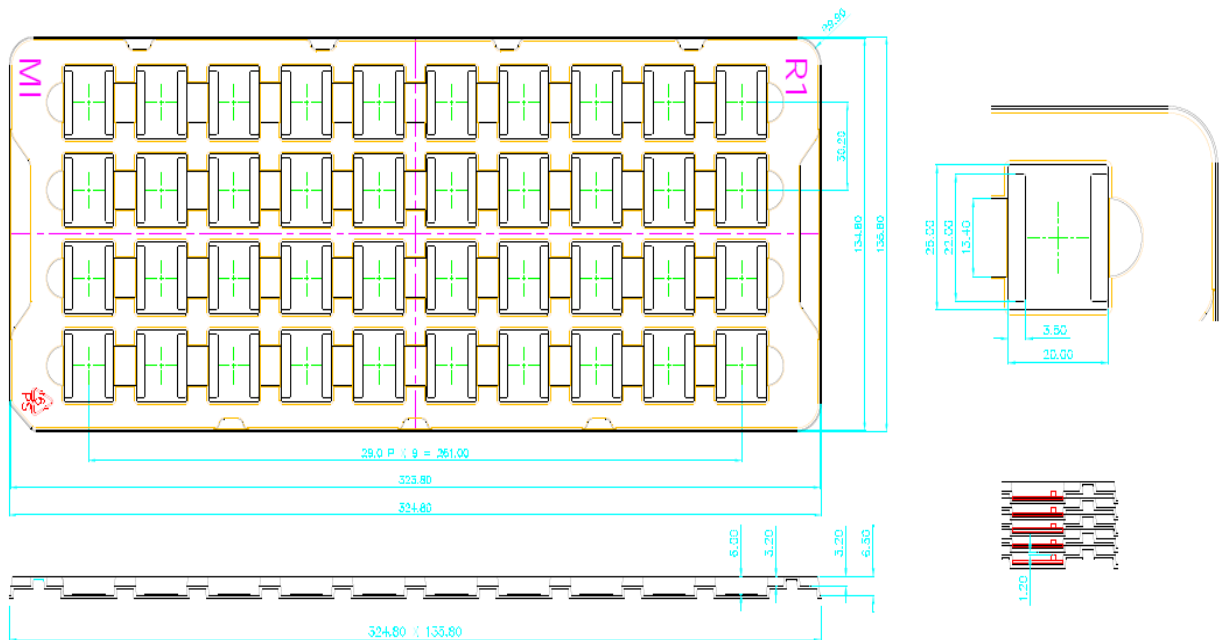


Figure 7 : Packing Tray

9.2. Box Packing



R1371T



- 40pcs/Tray (4x10)
- Stack 5 Tray (including one empty tray)
- Totally 160pcs (40x4)



- Vacuum sealing
- Cushion bar and bubble sheet
- Totally 320pcs (160x2)



320pcs/Inner box



- 1,280pcs/Carton (320x4)
- Stack 4 inner box

10. RoHS Compliance

Microinfinity's R1371T module and its homogeneous materials comply with European Union's restriction on use of hazardous substances("RoHS") Directive, 2002/95/EC.

11. Handling Precaution

This product includes quartz part. Please handle carefully paying attention to the next points. Quartz parts are precision parts. This crystal part is designed in consideration of shock resistance. However it may be destroyed depending on the condition of dropping and impact. Please be sure to check the characteristics in case that the product is dropped from the desktop and too much shock is applied to the products. When the products are automatically assembled (vacuum-chucking, mechanical chucking, assembling with other parts), the excessive shock may make the characteristics of quartz part change or deteriorate. So please set up the condition so that the shock becomes as small as possible. Please be sure to test in your site before use and confirm that there is no influence on the characteristics. And confirm similarly when the condition is changed. And be careful not to collide the product with the machinery or with other circuit board when/after assembling. Anti-static protection circuit is contained in this product. However, when the excessive static electricity is charged, IC may break. So please use conductive ones for packing and carrying containers. And use the soldering iron and the measurement instrument that don't have high-voltage leakage and take anti-static measures such as grounding when handling. Ultrasonic washing may lead to destruction of crystals depending on the condition. We can't guarantee it because we can't know your using condition (machine type, power, time, position in the tank etc.). If you are obliged to use it, please be sure to examine and set up the conditions beforehand.