

# YICHWAN

杭州益川电子有限公司  
Hangzhou Yichwan Electronics Co., Ltd.

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浙江益川驱动技术有限公司  
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## YICHWAN

益川

## 杭州益川电子有限公司

Hangzhou Yichwan Electronics Co., Ltd.

专注于高频、高精度变频驱动技术  
提供从硬件设计到生产制造、定制化软件开发与功能拓展  
算法优化到系统集成的全链路解决方案

Focusing on high-frequency, high-precision variable frequency drive technology,  
we provide end-to-end solutions covering hardware design and production, customized software development  
and function expansion, algorithm optimization, and system integration.

精益求精 Striving for excellence  
海纳百川 Embracing diversity



益川电子  
专注变频



“益川”取自精益求精，海纳百川。益川LOGO寓意：以益的大写字母Y为主，托起初升的太阳，蒸蒸日上；蓝色代表海洋源远流长，川流不息，创新持续不断。

The name Yichwan derives from the concepts of Keep improving and Never stop and embracing all with openness (from the Chinese idioms Jingyi Qiujiing and Haina Baichuan). The symbolism of the Yichwan logo is as follows: Centered on the uppercase letter Y (from Yi), it supports the rising sun, symbolizing prosperity and continuous growth; the blue color represents the ocean—enduring, ever-flowing, and a metaphor for unceasing innovation.



# 企业简介

## Company Profile

Hangzhou Yichwan Electronics Co., Ltd. was founded in 2016, with its core team originating from a China top 500 company. The name 'Yichwan' derives from the concepts of 'Keep improving and Never stop' and 'embracing all with openness' (from the Chinese idioms 'Jingyi Qiujing' and 'Haina Baichuan'). The symbolism of the Yichwan logo is as follows: Centered on the uppercase letter 'Y' (from 'Yi'), it supports the rising sun, symbolizing prosperity and continuous growth; the blue color represents the ocean-enduring, ever-flowing, and a metaphor for unceasing innovation. "**Keep improving and Never stop**" reflects Yichwan's commitment to product technology, quality, and the spirit of striving for perfection. "**embracing all with openness**" represents the company's open mind and tolerance for failures in innovation, valuing individuality and expertise, and persistently advancing groundbreaking ideas. Our core values are: Professionalism · Focus · Dedication · Excellence · Innovation · Collaboration · Technological Strengths.

With variable-frequency control technology as our competitive edge, we possess core software algorithms and intellectual property rights. Our team is led by software and hardware experts, with technical personnel accounting for over 50% of the workforce. We strive to produce the best products and contribute to energy conservation, environmental protection, and sustainability. Our products are widely used in HVAC, air source heat pumps, new energy vehicles, precision engraving machines, computer room air conditioners, and other fields. Our core technology products include air source heat pump controllers and components, controller software products, industrial frequency converters, compressor and motor drives, etc. Meanwhile, we can provide customers with hardware, software, and system control solutions.

Since its inception, Yichwan has been a driving force in advancing air-source heat pump technology, aligning with China's "Coal-to-Electricity" policy to promote green energy. Our innovations, such as intelligent defrosting systems, improve energy efficiency by over 30%, fulfilling our corporate responsibility in environmental sustainability.

Adhering to the development philosophy of openness, cooperation, and sharing, Yichwan integrates market research with product development. We strive to ensure precise technical positioning, accurate product direction, and clear market orientation, aiming to create blockbuster products one after another. Yichwan has signed industry-university-research cooperation agreements and strategic cooperation agreements with major universities. Both parties have established long-term cooperative relationships in technical exchanges, talent cultivation, project research, collaborative development and other aspects.

杭州益川电子有限公司成立于2016年，团队来自中国500强企业。益川两字取自精益求精，海纳百川。益川LOGO寓意，以益的大写字母Y为主，托起初升的太阳，蒸蒸日上；蓝色代表海洋源远流长，川流不息，创新持续不断。精益求精，是益川公司对产品技术，对产品品质的要求，追求卓越的一种精神；海纳百川是益川公司做人的胸怀、气魄，对创新要容忍失败，对有个性的人，有特长的人要包容，博采众长；对创新的理念要持续不断践行。我们的核心价值观是：专业、专注、专心；精益求精、追求卓越、博采众长。

变频控制技术是我们的优势，拥有核心的软件算法及相应的知识产权。软件、硬件专家领衔，技术人员占比50%以上，持续开发新产品，满足客户的需求。我们追求做最好的产品，对节能，绿色，环保做出我们的贡献。我们的产品广泛应用于空调暖通、空气源热泵、新能源汽车、精雕机设备、机房空调等领域。空气源热泵控制器及组件，控制器软件产品，工业变频器，压缩机和电机驱动等是我们的核心技术产品。同时，我们可以为客户提供硬件、软件及系统的控制解决方案。

公司自成立以来，着力推动空气源热泵行业发展，迎合国家煤改电政策，倡导绿色环保，现如今，我们的技术能实现精准化霜，节能达30%以上为国家和人民在环保事业上做出企业应有的责任和奉献；

公司坚持开放、合作、共享的发展理念，专注市场研究与产品开发相结合，努力做到技术定位准确、产品方向准确，市场方向准确，打造款款爆品。公司与各大高校签订了产学研合作协议书及战略合作协议，双方在技术交流、人才培养、课题研究、合作开发等方面建立了长期合作关系。



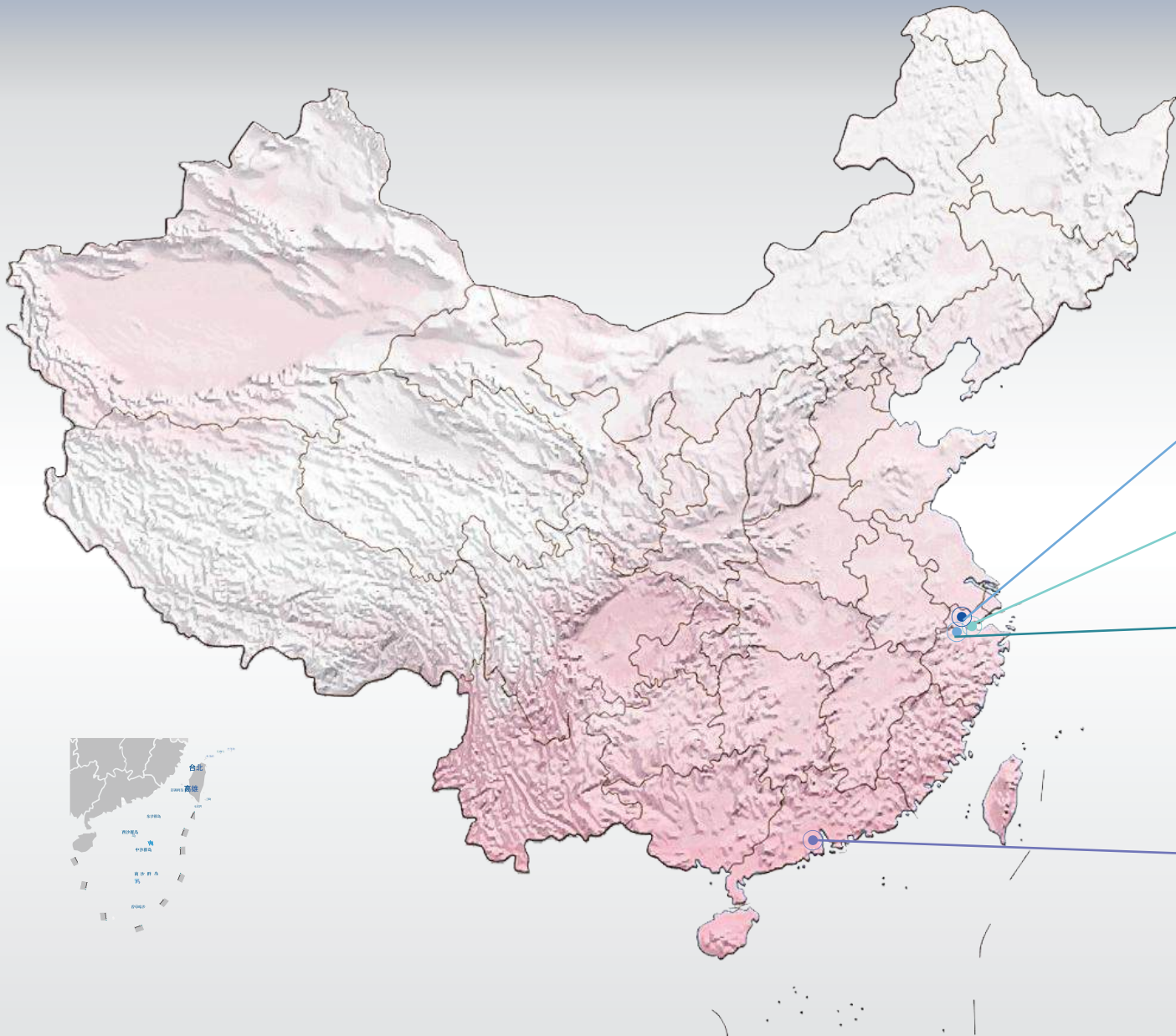


# 企业发展历程

## Company Milestones



企业规模  
Enterprise Scale



厂区风貌 Campus Landscape



企业总部  
Corporate  
Headquarters

杭州益川电子有限公司  
Hangzhou Yichwan Electronics Co., Ltd.

浙江省杭州市良渚街道祥运路319号博世华环保产业园A幢602。  
涵盖营销中心，研发中心，运营中心，财务中心，质量管理中心等。

制造中心  
Manufacturing  
Center

浙江益川驱动技术有限公司  
Zhejiang Yichwan Drive Technology Co., Ltd.

浙江省湖州市德清禹越镇振兴路9号万马智能制造工业园19号楼  
涵盖制造中心，仓库储存，工艺中心，设备管理，产品配送等。

国际贸易  
International  
Trade

浙江益川智控国际贸易有限公司  
Zhejiang Yichwan Intelligent Control International Trade Co., Ltd.

浙江省湖州市德清禹越镇振兴路9号万马智能制造工业园19号楼  
涵盖外贸销售，客户拓展，技术支持，财务，软件研发等。

广东分部  
Guangdong Branch

佛山益川智控电子有限公司  
Foshan Yichwan Intelligent Control Electronics Co., Ltd.

广东省佛山市顺德区陈村镇宏裕公馆1栋1909室  
涵盖区域销售，技术支持，财务，软件研发等。

厂区介绍 Facility Introduction

浙江益川驱动技术有限公司位于万马智能制造工业园19号楼，厂区占地面积1500余平方米，厂区可用面积达到6000余平方米，厂区涵盖研发中心，质检中心，SMT车间，DIP车间，成品仓库，原料仓库，销售中心等，为益川高质量产品竭力护航，匠心益川，启航。  
万马（禹越）融杭智造产业园项目以“工业自动化”为产业定位，在改造老旧园区的基础上重点引进符合国家战略发展的装备制造、电子信息产业以及高自动化率的智能制造企业。致力于打造集生产制造、研发设计、企业总部、产品展示功能于一体的城市工业新场所和产城融合新标杆。

Zhejiang Yichuan Drive Technology Co., Ltd. located at Building 19, Wanma Intelligent Manufacturing Industrial Park. Facility Specifications: Total Site Area: 1,500+ sqm, Utilizable Space: 6,000+ sqm (multi-level optimization). Key Functional Zones: R&D Center (ISO-certified lab). Quality Inspection Center (with AOI/X-ray equipment); SMT Workshop (Yamaha high-speed placement machines); DIP Workshop (Wave soldering line); Finished Goods Warehouse (WMS managed); Raw Material Warehouse (ERP integrated) Sales & Exhibition Center.



## Company Honors

海纳百川







## 专利证书 Certificate of Patent



## 12项/Items 发明专利 Invention Patent



## 10项/Items 实用新型专利 Utility Model Patent



## 38项/Items 软件著作权 Copyright of Software



# CQC 认证证书

## COC Authentication certificates

# 益川热泵软件著作权

## Yichwan Electronics Heat Pump Software Copyright

# 益川空调软件著作权

## Yichwan Electronics Air Conditioning Software Copyright

# 益川变频驱动软件著作权登记证

## Yichwan Electronics Variable Frequency Drive Software Copyright Registration Certificate

# 益川商标注册证

## Yichwan Electronics trademark registration certificate

# GB/T 19001-2016/ISO 质量管理体系

## GB/T 19001-2016/ISO 9001:2015 Quality Management Systems - Requirements





# 企业服务市场

Corporate Services Market

我们的产品广泛应用于空调暖通、空气源热泵、新能源汽车、精雕机设备、机房空调等领域。空气源热泵控制器及组件，控制器软件产品，工业变频器，伺服驱动器压缩机和电机驱动等是我们的核心技术产品。同时，我们可以为客户提供硬件、软件及系统的控制解决方案。我们的销售服务覆盖全国，产品畅销各个地区，另外还在积极拓展海外市场。现如今，我们的技术能实现精准化霜，节能达30%以上，为国家和人民在环保事业上做出企业应有的责任和奉献；

"Our products are widely applied in  
HVAC (Heating, Ventilation & Air Conditioning);  
Air-source heat pumps;  
New energy vehicles (NEVs);  
Precision engraving machinery;  
Data center air conditioning systems;

Core technologies include:  
Controllers & components for air-source heat pumps;  
Control software solutions;  
Industrial frequency converters;  
Compressor and motor drive systems.





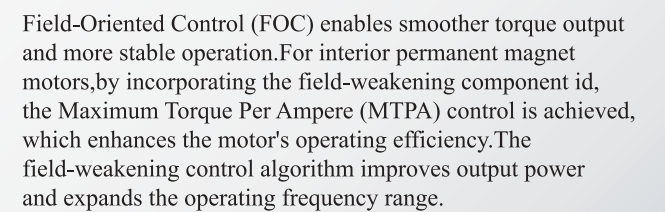


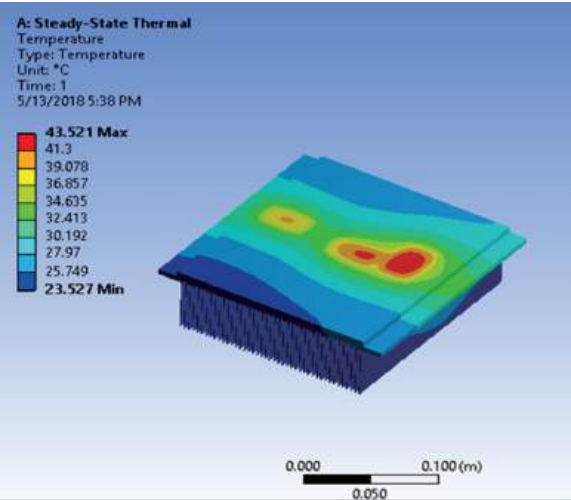


- 
- 120°  
矩形波
- 30° 120° 60°
- 时间 →
- 120°
- 电流
- 电压
- 120度方波**  
120 degrees rectangular current
- 180°  
正弦波
- 180°
- 时间 →
- 电流
- 电压
- 180度正弦波**  
180 degrees sinusoidal wave

**FOC 算法原理**

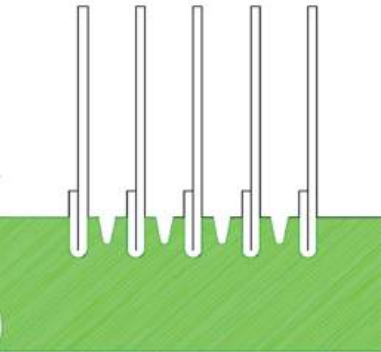
The diagram illustrates the FOC algorithm principle for an IPMSM. The process starts with a reference speed  $\omega^*$ , which is compared with the estimated speed  $\hat{\omega}$  and fed into a PI controller. The output of the PI controller is the reference torque, which is then processed by the MTPA/weak magnetic control/torque control block to generate reference currents  $i_{d\_ref}$  and  $i_{q\_ref}$ . These reference currents are compared with the actual d-axis and q-axis currents  $i_d$  and  $i_q$  (obtained from the 2/3 coordinate transformation) and fed into two separate PI controllers. The outputs of these PI controllers are the d-axis and q-axis voltage commands  $u_d$  and  $u_q$ . These voltage commands are then processed by the 2/3 coordinate transformation block to generate the three-phase voltage commands  $u_a$ ,  $u_b$ , and  $u_c$ . These voltage commands are fed into the SV PWM block, which generates the three-phase PWM signals for the inverter. The inverter drives the IPMSM, which provides the three-phase currents  $i_a$ ,  $i_b$ , and  $i_c$  back to the 2/3 coordinate transformation block. The 2/3 coordinate transformation block also provides the estimated rotor position  $\hat{\theta}$  and estimated speed  $\hat{\omega}$  to the feedback loops.



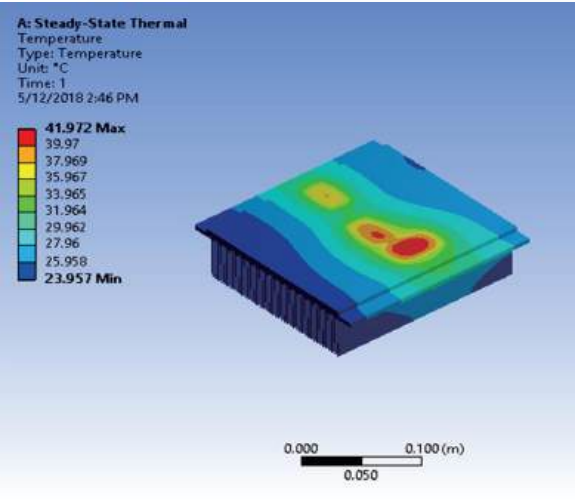


1.散热片折叠仿真效果

1.Simulation results of folding cooling fin

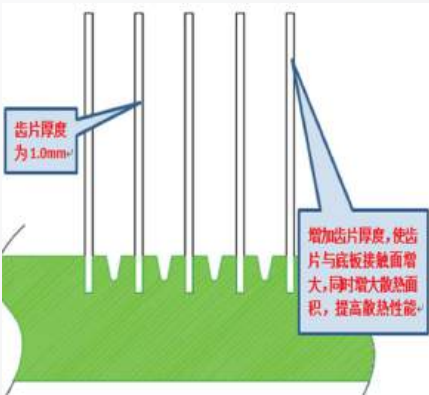


传导Conduction: 100W on 3 faces  
对流Convection: 20W/m2\*℃  
最高温度Maximum temp: 43.521℃

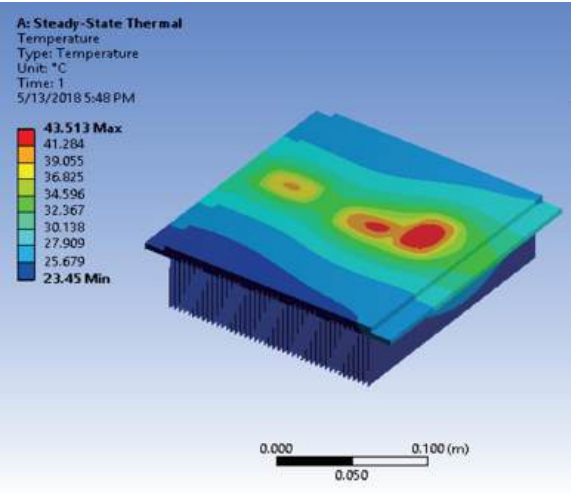


4.散热片厚度增加到1mm仿真结果

4.Simulation results when increase the thickness of the cooling fin to 1mm .

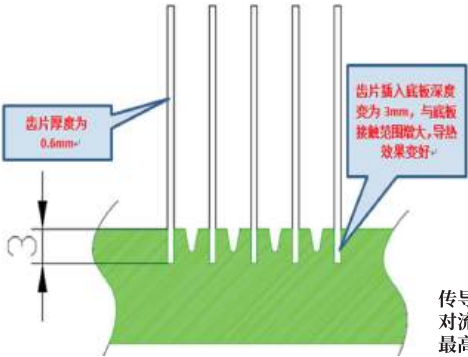


传导Conduction: 100W on 3 faces  
对流Convection: 20W/m2\*℃  
最高温度Maximum temp: 41.972℃

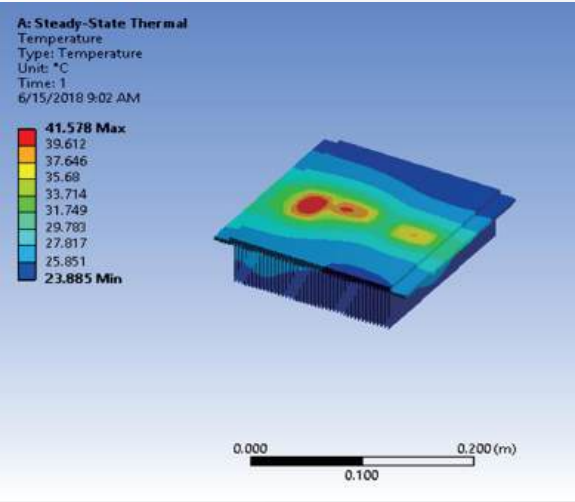


2.散热片插入深度更改为3mm仿真结果

2.Simulation results when change the insertion depth of the cooling fin into 3mm

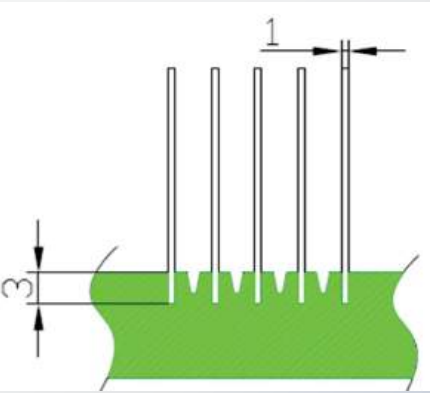


传导Conduction: 100W on 3 faces  
对流Convection: 20W/m2\*℃  
最高温度Maximum temp: 43.521℃

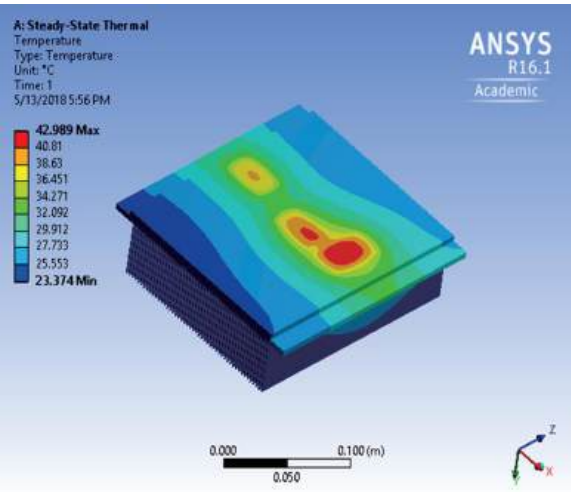


5.散热片厚度增加到1mm仿真结果

5.Simulation results when increase the thickness of the cooling fin to 1mm .

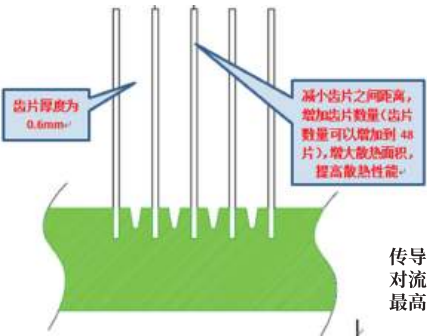


传导Conduction: 100W on 3 faces  
对流Convection: 20W/m2\*℃  
最高温度Maximum temp: 41.578℃



3.散热片数量增加到48片仿真结果

3.Simulation results when increase the number of the cooling fin to 48



传导Conduction: 100W on 3 faces  
对流Convection: 20W/m2\*℃  
最高温度Maximum temp: 42.989℃

6.实验结果对比

6.Comparison of experimental results

| 散热片加工方式<br>Processing method of the cooling fin                                                             | 仿真结果(℃)<br>Simulation results (℃) |
|-------------------------------------------------------------------------------------------------------------|-----------------------------------|
| 散热片翅片折叠<br>Folding gear of the cooling fin                                                                  | 43.521                            |
| 散热片翅片插入深度3mm<br>3mm-insertion depth of the gear of the cooling fin                                          | 43.513                            |
| 散热片翅片数量增加到48片<br>Increase the number of the gear of the cooling fin to 48                                   | 42.989                            |
| 散热片翅片厚度增加到1mm<br>Increase the fin thickness of the cooling fin to 1mm                                       | 41.972                            |
| 散热片翅片厚度增加到1mm插入深度3mm<br>Increase the fin thickness of the cooling fin to 1mm and the insertion depth to 3mm | 41.578                            |

实验条件Experiment conditions:

传导Conduction: 100W on 3 faces  
对流Convection: 20W/m2\*℃

通过仿真对比可发现, 在相同条件下, 散热片翅片厚度增加1mm插入3mm散热效果最好。

Based on the simulation comparison, it is found that under the same conditon,the heat dissipation effect isthe best when the thickness cooling fin is increased to 1mm and the insertion depth is 3mm.



# 实验测试

## Experimental Testing



### 01.

#### 电气测试 Electrical Testing

- 浪涌冲击抗扰度试验  
Surge Immunity Test
- 电快速瞬变脉冲群抗扰度试验  
Electrical Fast Transient/Burst Immunity Test
- 谐波电流发射限值测试  
Harmonic Current Emission Limit Test
- 骚扰电压测试  
Disturbance Voltage Test
- 静电放电抗扰度试验  
Electrostatic Discharge Immunity Test
- 绝缘耐压/电阻  
Insulation Withstand Voltage /Resistance Test
- 骚扰功率测试  
Disturbance Power Test
- 安规测试  
Safety Compliance Testing



### 02.

#### 可靠性测试 Reliability Testing

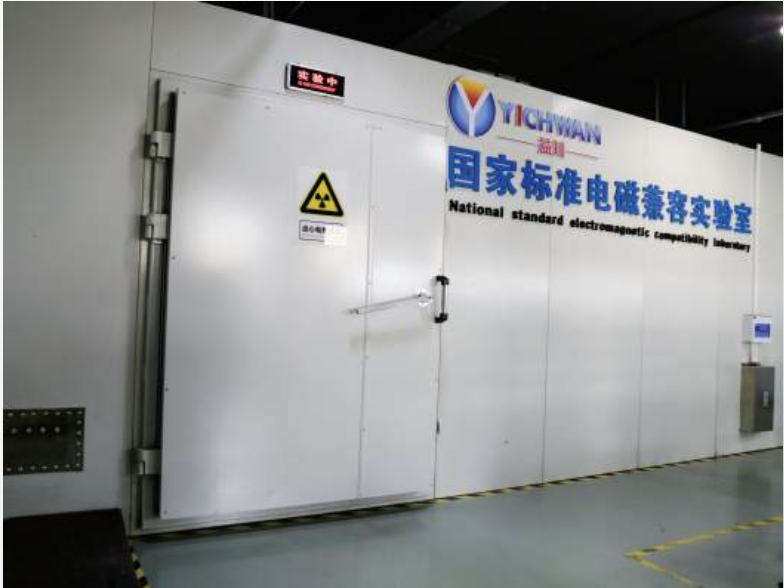
- 盐雾实验  
Salt Spray Test
- 耐湿性  
Moisture Resistance
- 温升测试  
Temperature Rise Test
- 储存实验  
Storage Test
- 冷热冲击实验  
Thermal Shock Test
- 振动测试  
Vibration Testing
- 红外热释放  
Infrared Thermal Release
- 高低温测试  
High and Low Temperature Test



### 03.

#### 整机测试 Complete Machine Testing

- 驱动可靠性评价实验  
Drive Reliability Evaluation Test
- 电控温升测试  
Electrical Control System Temperature Rise Test
- 控制逻辑可靠性验证  
Control Logic Reliability Verification



### 04.

#### 实验项目（部分） Experimental project (partial)

- 型式试验  
Type Testing
- 可靠性试验  
Reliability Test
- 最恶品试验  
Worst-Case Testing
- 系统评价项目：81项  
Systematic Evaluation Project:81 Items
- 硬件评价项目：29项  
Hardware Evaluation Project:29 Items
- 软件评价项目：16项  
Software Evaluation Project:16 Items





## 压缩机测试台已精准匹配型号

The models precisely matched by the compressor test bench.

| 品牌<br>Brand | 型号<br>Model   | 品牌<br>Brand | 型号<br>Model    | 品牌<br>Brand | 型号<br>Model    |
|-------------|---------------|-------------|----------------|-------------|----------------|
| Panasonic   | 588072ZJA21   | Panasonic   | H420D7KZABJ6   | Mitsubishi  | LYK80FTBMC     |
| Panasonic   | 5SS072ZHA01   | Panasonic   | H650D5VZAAJ2   | Mitsubishi  | LNK65F         |
| Panasonic   | 5SS072ZGE21   | Panasonic   | 5RD160ZAA21    | Mitsubishi  | LNB80FANMC     |
| Panasonic   | 7TD062ZAA61   | Panasonic   | 5KD420ZBA21    | Mitsubishi  | HNB78FD-YEHC   |
| Panasonic   | 6TD058XAA41   | Panasonic   | H650D5VZAAC2   | Mitsubishi  | MVB33FKOMC-1   |
| Panasonic   | 6TD075ZAA41   | Panasonic   | 5RL160ZAA21    | Mitsubishi  | ANB33~ANB87    |
| Panasonic   | 5RS102ZAA01   | Panasonic   | H420D5VZAAJ2   | Mitsubishi  | LVB53FCAMC     |
| Panasonic   | 5RD132ZGA21   | Panasonic   | 9VD420ZAA2J    | Mitsubishi  | MNB42FDAMC     |
| Panasonic   | 5RL138ZAA21   | Panasonic   | 5VD420ZAA21    | Mitsubishi  | MNB36FAAMC     |
| Panasonic   | 5RD198ZAA21   |             |                | Mitsubishi  | MNB42FFQMC-L   |
| Panasonic   | 9RD138ZBA2J   | Mitsubishi  | KNB065FYJMC    | Mitsubishi  | MNK42FDLMC-L   |
| Panasonic   | 5RD160ZAA21   | Mitsubishi  | ANB33FKUMTS    | Mitsubishi  | MNB42FCKMC-L   |
| Panasonic   | 5KD240ZCA21   | Mitsubishi  | ANB33FUEMTS    | Mitsubishi  | MVB42FCPMC-L   |
| Panasonic   | 5VD330ZAA21   | Mitsubishi  | ANB42FKUMTS    | Mitsubishi  | MYK53F (Cu)    |
| Panasonic   | 5VD420ZKA21   | Mitsubishi  | ANB42FUEMTS    | Mitsubishi  | MYK53FQDMC     |
| Panasonic   | 9KD420ZAA2J   | Mitsubishi  | ANB52FKPMTS    | Mitsubishi  | MNK42FDMMC-L   |
| Panasonic   | 6KD420ZAA21   | Mitsubishi  | ANB66FUFMTS    | Mitsubishi  | MNB42FFDMC-L   |
| Panasonic   | 9RD220ZAA2J   | Mitsubishi  | ANB66FVAMTS    | Mitsubishi  | MNB42FCTMC     |
| Panasonic   | H550D5VZAAJ2  | Mitsubishi  | ANB78FVAMTS    | Mitsubishi  | MNB42FNDMC-L   |
| Panasonic   | 5VL420ZAA21   | Mitsubishi  | ANB87FVMTS     | Mitsubishi  | MNB42FCDMC-L   |
| Panasonic   | H800D5JZAAJ2  | Mitsubishi  | KNB102FADMC    | Mitsubishi  | MBB42FFDMC-L   |
| Panasonic   | H800D9JZAAJ2  | Mitsubishi  | KNB102FEEMC    | Mitsubishi  | SVB200FJFMC    |
| Panasonic   | 9VD650ZAA2J   | Mitsubishi  | KVB102FEUMC    | Mitsubishi  | SNB200FGMMC    |
| Panasonic   | 5CD081ZA02    | Mitsubishi  | LNB53FCAMC     | Mitsubishi  | TVB220FAEMC    |
| Panasonic   | C-SDP330H02B  | Mitsubishi  | NB40FMLMC-L    | Mitsubishi  | LYK80FABMC-L   |
| Panasonic   | C198D5RZAAAC2 | Mitsubishi  | MNB42ZFAMC-L   | Mitsubishi  | LYK65FABMC     |
| Panasonic   | C220D5RZABC2  | Mitsubishi  | MVB42FCBMC-L   | Mitsubishi  | LVB65FAEMC     |
| Panasonic   | 6TD075ZAB41   | Mitsubishi  | MYK42FABMC     | Mitsubishi  | LBB65FAEMC     |
| Panasonic   | 5RD138ZAA21   | Mitsubishi  | MYK53F (A1)    | Mitsubishi  | LNB65FTEMC     |
| Panasonic   | H138D5RZAAT2  | Mitsubishi  | SNB110FGAMC    | Mitsubishi  | LNB65FAEMC     |
| Panasonic   | 5RL160ZAA21   | Mitsubishi  | SVB110FHDMC    | Mitsubishi  | LNB80F (A1)    |
| Panasonic   | 5KD420ZAA21   | Mitsubishi  | SNB140FUPMC    |             |                |
| Panasonic   | 9RD220ZAA21   | Mitsubishi  | SNB140FULMC    | GMCC        | ASK75D43UER    |
| Panasonic   | H550D5VZABT2  | Mitsubishi  | SVB172FNPMC    | GMCC        | KSK75D43UEZA   |
| Panasonic   | 5VD420ZAA21   | Mitsubishi  | SNB172FTGMC    | GMCC        | RJSK75D29EZE   |
| Panasonic   | H800D5JZAAJ2  | Mitsubishi  | SNB200FKMMC-L1 | GMCC        | KSK82D22UEZA31 |
| Panasonic   | 6TD058XCA41   | Mitsubishi  | SVB220FLGMC-L  | GMCC        | ASN98D22UFZ    |
| Panasonic   | 6TD075XAA41   | Mitsubishi  | TNB220FFEMC    | GMCC        | KSN98D21UEZ31  |
| Panasonic   | H420D5KZAAJ2  | Mitsubishi  | TNB220FLHMC    | GMCC        | EAQN108D22UFZA |
| Panasonic   | 9VD550ZCA2J   | Mitsubishi  | SPB280FTOMC    | GMCC        | KSK89D53UEZ    |
| Panasonic   | 5RD198ZAA21   | Mitsubishi  | TVE306FHTHC    | GMCC        | RJSK89D21EZ4C  |



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压缩机测试台已精准匹配型号

The models precisely matched by the compressor test bench.

| 品牌<br>Brand | 型号<br>Model    | 品牌<br>Brand | 型号<br>Model        | 品牌<br>Brand | 型号<br>Model        |
|-------------|----------------|-------------|--------------------|-------------|--------------------|
| GMCC        | KSK89D32UEZA31 | GMCC        | ATF420D50UMV       | Hitachi     | WHP32900AEKTQ9JK   |
| GMCC        | KSK103D33UEZ3  | GMCC        | JZM400D53TMCQ      | Hitachi     | ATE752SKTQ9JKP     |
| GMCC        | ASN140D21UFZ   | GMCC        | ETDF420D62EMT      | Hitachi     | WHP04000VRKQA6JT6  |
| GMCC        | KSN098D32UEZ   | GMCC        | EAPQ440D1UMUB      | Hitachi     | WHP09100AEKPA8LT6B |
| GMCC        | KSN108D32UFZ   | GMCC        | EAPQ440D1UMUA      | Hitachi     | WHP09100AUKPA8LT6  |
| GMCC        | GJSN140D33TFZ3 | GMCC        | ATQ360D1UMU        | Hitachi     | WHP09100GEKPA8LT6B |
| GMCC        | ASN108D32UFZ   | GMCC        | ATQ420D1UMU        | Hitachi     | GTD226UKPA8LT6C    |
| GMCC        | KSN140D33UFZ3  | GMCC        | EAPQ420D1SMU       | Hitachi     | WHP09100GEKQA8LT8  |
| GMCC        | EAPN150D33UFZ3 | GMCC        | KTQ420D1UMU        | Hitachi     | WHP07600PSKQA6LT8  |
| GMCC        | KZN110D33UDC3  | GMCC        | ETDQ580D2ENT       | Hitachi     | WHP09100GKXA8LQ8   |
| GMCC        | KTN150D53UFZ3  | GMCC        | SEAVC084D73ULK     | Hitachi     | GTD216KXA8LL8      |
| GMCC        | KZN150D53UDC3  | GMCC        | SGAGC084D73ULK     | Hitachi     | WHP11500AEKPC9EQ   |
| GMCC        | KTN150D63UFZR3 | GMCC        | SAVC084D73ULK      | Hitachi     | BBH420SKPB8FV      |
| GMCC        | KTN150D42UFZ   |             |                    | Hitachi     | WHP11500GUDPC9EQ   |
| GMCC        | EAPN150D42UFZ  | Hitachi     | GSD098SKSA7JL6B    | Hitachi     | WHP11500ASDPC9EQ   |
| GMCC        | KTN210D60UMT3  | Hitachi     | WHP01750ARKPA6JG6  | Hitachi     | WHP11500AEDPC9EQ   |
| GMCC        | KTN210D61UFUC3 | Hitachi     | BSA586SDMY3FJ      | Hitachi     | WHP12900GEKPA8LT8  |
| GMCC        | GJTN210D61TFU3 | Hitachi     | BSA804SD-A3BUA     | Hitachi     | WHP12900GSKPA8LT8  |
| GMCC        | EAPF420D64UMU  | Hitachi     | BSA804SD-A6JUA     | Hitachi     | MTD280SKPC8LT8C    |
| GMCC        | ATF400D64UMV   | Hitachi     | GSD102SKQA6JT6B    | Hitachi     | WHP15600AEKPC9EQ   |
| GMCC        | EATF400D64UMV  | Hitachi     | WHP04000VRKQA6JT6  | Hitachi     | MTH420SKPC8FQ      |
| GMCC        | KTF400D64UMTA  | Hitachi     | WHP04200AEKQA7JT6B | Hitachi     | ATH420SKPC8FQC     |
| GMCC        | EKPF420D64UMUR | Hitachi     | BBD226SKQA3D6      | Hitachi     | GTH420SKPC8DQ      |
| GMCC        | EAPM240D43UMT  | Hitachi     | VBD110SKMA3D6      | Hitachi     | GTH420SKPC9EQC     |
| GMCC        | KTM225D43UMT   | Hitachi     | GSD140RKPF7JV6     | Hitachi     | WHP15600AEDPC9EQ   |
| GMCC        | KSK75D43UEZA   | Hitachi     | WHP05800ARKRA7JV8  | Hitachi     | WHP07600PSDPC9KQ   |
| GMCC        | KTM240D43UKT   | Hitachi     | WHP05800AEKRA7JV8B | Hitachi     | WHP11500AEDPC9EQ   |
| GMCC        | EAPM310D85UMT  | Hitachi     | VBD150LKQA3D6      | Hitachi     | WHP13100AEDPC9EQ   |
| GMCC        | KTM310D85UMT   | Hitachi     | WHP06100GRKQA7JV6C | Hitachi     | WHP15600ASDPC9EQ   |
| GMCC        | GJTF310D43TMT  | Hitachi     | WHP07850AUKQA8JT6T | Hitachi     | BTH550SDPC8FQA     |
| GMCC        | EKPF310D46UMUR | Hitachi     | WHP05600AUKQA8JT6  | Hitachi     | WHP15600AEKRC9EQA  |
| GMCC        | KTM240D57UMT   | Hitachi     | WHP07850AEKRA7JT6T | Hitachi     | WHP32900AEKTQ9JK   |
| GMCC        | ATM240D57UMT   | Hitachi     | WHP03400ARKQH6JU6B | Hitachi     | WHP15600ASDPC9EQ   |
| GMCC        | EAPM240D57UMT  | Hitachi     | BTD226SKQA6NT8V    | Hitachi     | WHP15600VSDPC9EQ   |
| GMCC        | ATM180D57UMT   | Hitachi     | VTD280SKQA6LT8     | Hitachi     | WHP15600AEDPC9EQ   |
| GMCC        | KTM180D57UMT   | Hitachi     | WHP09100GEKQA8LT8  | Hitachi     | VBH420SDPB9MA      |
| GMCC        | SAVA042D23ULK  | Hitachi     | VTD280SKQA6LT8     | Hitachi     | BTH420SDPC9EQ      |
| GMCC        | SAVA055D56ULK  | Hitachi     | MTD226RKQA8LV8C    | Hitachi     | DTH254LDPC9EQ      |
| GMCC        | SAVC060D11ULK  | Hitachi     | ATE848SKTQ9JKP     | Hitachi     | WHP09500AEDPC9EQ   |
| GMCC        | SAVC070D44ULK  | Hitachi     | VTE848SKTQ9JK      | Hitachi     | DBH356LDPB5M       |
| GMCC        | SRAVC070D44ULK | Hitachi     | WHP37600AEKTQ9JKC  | Hitachi     | ALT232SDNC9AU      |

| 品牌<br>Brand | 型号<br>Model    | 品牌<br>Brand | 型号<br>Model     | 品牌<br>Brand | 型号<br>Model |
|-------------|----------------|-------------|-----------------|-------------|-------------|
| Sanyo       | C-4RZ089H3BBF  | Hitachi     | DD98PHDG-D1Y2   |             |             |
| Sanyo       | C-1RZ100H3KAF  | Hitachi     | DD110KHDG-D1K2  |             |             |
| Sanyo       | C-1RZ107H1HBF  |             |                 |             |             |
| Sanyo       | C-6RHZ125H1ABF | 东芝          | DA422A3FJ-28UZA |             |             |
| Sanyo       | C-7RVN113LOB   | 东芝          | ZWW130SP-4X9    |             |             |
| Sanyo       | C-6RNVN103HOW  |             |                 |             |             |
| Sanyo       | C-6RHZ092H3ABF | WR          | WR180GD220SHG1  |             |             |
| Sanyo       | C-7RZ233L4BAL  |             |                 |             |             |
| Sanyo       | C-7RHZ233H1AAF | 凌达          | QXAS-F428zX450L |             |             |
| Sanyo       | C-5RZ146H3ADF  | 凌达          | QXFS-F428zX450E |             |             |
| Sanyo       | C-7RNVN153LOB  | 凌达          | QXAS-F65zN030AA |             |             |
| Sanyo       | C-6RZ210L4AAL  | 凌达          | QX-B18zE030     |             |             |
| Sanyo       | C-8RZ580L4BAL  | 凌达          | QXFb-B238zX070  |             |             |
| Sanyo       | C-7RZ320L4DAL  | 凌达          | ARz-CM320AHAF   |             |             |
| Sanyo       | C-7RZ420L4BAL  |             |                 |             |             |
| Sanyo       | C-8RZ580H3BAF  | 比泽尔         | KDD102pZD035    |             |             |
| Sanyo       | C-7RVN273H0W   |             |                 |             |             |
| Sanyo       | C-7RZ420L4AAL  |             |                 |             |             |
| Sanyo       | C-8RZ486L4BAL  |             |                 |             |             |
| Sanyo       | C-9RZ700L4AAL  |             |                 |             |             |
| Sanyo       | C-9RZ700H1AAF  |             |                 |             |             |
|             |                |             |                 |             |             |
| Invotech    | YIW38C1G-V100  |             |                 |             |             |
| Invotech    | YIW60C1G-V100  |             |                 |             |             |
|             |                |             |                 |             |             |
| Copeland™   | ZPV0802E-4X9   |             |                 |             |             |
| Copeland™   | ZWW130SP-4X9   |             |                 |             |             |
| Copeland™   | ZRHV72KTE-TX7  |             |                 |             |             |
|             |                |             |                 |             |             |
| Hitachi     | ZS1216D1       |             |                 |             |             |
| Hitachi     | E405DHD-38D2G  |             |                 |             |             |
| Hitachi     | AA55PHDG-D1K2  |             |                 |             |             |
| Hitachi     | AA55PHDG-D1S2  |             |                 |             |             |
| Hitachi     | CB65KHDG-D1K2  |             |                 |             |             |
| Hitachi     | E655DHD-65D2G  |             |                 |             |             |
| Hitachi     | CA80KHDG-D1K2  |             |                 |             |             |
| Hitachi     | CA80KHDG-D1Y2  |             |                 |             |             |
| Hitachi     | DA84DHDG-D1S2  |             |                 |             |             |
| Hitachi     | DD98PHDG-D1S2  |             |                 |             |             |
| Hitachi     | DD98KHDG-D1K2  |             |                 |             |             |
| Hitachi     | DD98PHDG-D1Y2  |             |                 |             |             |



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实验测试

Experimental Testing

6. 实验数据:

6.1 测试数据

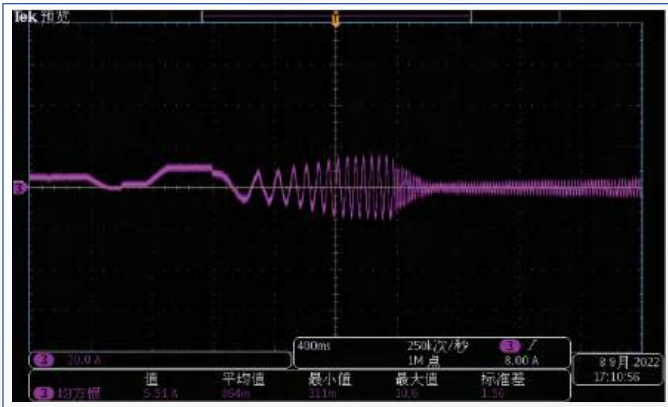
| 序号 | 转 速<br>rpm<br>rps | 转速<br>rpm | 排气<br>压力<br>MPa | 吸气<br>压力<br>MPa | 吸气<br>温度<br>℃ | 排气<br>温度<br>℃ | 液体<br>温度<br>℃ | 过热度<br>K | 过冷<br>度<br>K | 输入<br>电流<br>A | 压机<br>电流<br>A |
|----|-------------------|-----------|-----------------|-----------------|---------------|---------------|---------------|----------|--------------|---------------|---------------|
| 1  | 20                | 1200      | 1.271           | 0.704           | 9.4           | 40.4          | 16.9          | 9.12     | 1.29         | 2.6           | 6.3           |
| 2  | 20                | 1200      | 1.568           | 1.155           | 19.2          | 31.4          | 21.8          | 4.14     | 3.59         | 2.7           | 6.5           |
| 3  | 20                | 1200      | 1.363           | 0.173           | -25.8         | 43.4          | 18.1          | 3.75     | 2.44         | 3.1           | 7.7           |
| 4  | 20                | 1200      | 1.787           | 0.174           | -21.1         | 79.9          | 15.2          | 8.37     | 14.9         | 3.8           | 9.9           |
| 5  | 30                | 1800      | 3.328           | 0.472           | -1.4          | 88.6          | 17.6          | 8.57     | 37.37        | 8.7           | 17.8          |
| 6  | 30                | 1800      | 3.332           | 1.150           | 23.5          | 71.4          | 30.1          | 8.58     | 24.87        | 8.7           | 18.0          |
| 7  | 36                | 2160      | 4.174           | 0.703           | 5.7           | 93.5          | 18.0          | 5.42     | 46.99        | 12.2          | 22.1          |
| 8  | 36                | 2160      | 4.183           | 1.165           | 22.0          | 72.0          | 58.6          | 6.66     | -6.49        | 12.0          | 22.3          |
| 9  | 40                | 2400      | 2.048           | 1.550           | 31.0          | 44.1          | 30.4          | 6.02     | 4.81         | 6.2           | 9.4           |
| 10 | 40                | 2400      | 2.632           | 0.225           | -23.4         | 90.3          | 16.5          | 1.84     | 28.61        | 8.9           | 14.2          |
| 11 | 40                | 2400      | 3.736           | 0.476           | -6.9          | 100.6         | 17.8          | 2.87     | 42.23        | 12.0          | 20.3          |
| 12 | 40                | 2400      | 3.733           | 1.556           | 33.0          | 78.1          | 50.1          | 7.88     | 9.89         | 12.0          | 20.6          |
| 13 | 40                | 2400      | 4.175           | 1.351           | 25.1          | 81.6          | 47.3          | 4.86     | 17.7         | 13.3          | 23.0          |
| 14 | 60                | 3600      | 1.382           | 0.176           | -26.0         | 54.6          | 17.4          | 3.29     | 3.61         | 8.4           | 9.0           |
| 15 | 60                | 3600      | 1.377           | 0.705           | 4.5           | 40.6          | 19.0          | 4.37     | 2.01         | 8.4           | 9.0           |
| 16 | 60                | 3600      | 1.545           | 1.162           | 22.8          | 38.6          | 18.1          | 7.55     | 6.77         | 8.7           | 9.4           |
| 17 | 60                | 3600      | 1.789           | 0.172           | -27.6         | 86.7          | 16.3          | 2.04     | 13.84        | 9.8           | 11.0          |
| 18 | 60                | 3600      | 2.036           | 1.550           | 30.3          | 46.0          | 30.6          | 5.32     | 4.38         | 10.2          | 11.9          |
| 19 | 60                | 3600      | 2.624           | 0.224           | -23.3         | 95.0          | 18.3          | 2.02     | 26.69        | 12.6          | 14.9          |
| 20 | 60                | 3600      | 3.331           | 0.469           | -4.7          | 92.1          | 16.7          | 5.42     | 38.31        | 15.4          | 18.5          |
| 21 | 60                | 3600      | 3.736           | 0.474           | -6.5          | 97.3          | 16.4          | 3.62     | 43.63        | 17.1          | 20.5          |
| 22 | 60                | 3600      | 3.734           | 1.548           | 32.3          | 76.5          | 49.3          | 7.36     | 10.73        | 17.3          | 21.5          |
| 23 | 60                | 3600      | 4.181           | 0.701           | 4.7           | 90.1          | 23.5          | 4.53     | 41.59        | 18.9          | 22.9          |
| 24 | 60                | 3600      | 4.171           | 1.343           | 27.8          | 82.8          | 45.8          | 7.76     | 19.19        | 19.1          | 23.7          |
| 25 | 100               | 6000      | 1.474           | 0.169           | -27.2         | 59.5          | 16.5          | 2.71     | 8.37         | 14.8          | 12.6          |
| 26 | 100               | 6000      | 1.779           | 0.224           | -20.3         | 75.1          | 15.1          | 5.02     | 15.0         | 20.3          | 18.2          |
| 27 | 100               | 6000      | 1.498           | 0.698           | 8.6           | 47.5          | 20.3          | 8.47     | 4.57         | 16.6          | 13.9          |
| 28 | 100               | 6000      | 2.040           | 1.543           | 28.1          | 54.7          | 25.1          | 3.28     | 9.88         | 22.5          | 18.8          |
| 29 | 100               | 6000      | 3.735           | 0.467           | -8.0          | 108.1         | 15.6          | 2.22     | 44.43        | 28.7          | 24.8          |
| 30 | 100               | 6000      | 4.178           | 0.705           | 5.0           | 103.1         | 20.5          | 4.68     | 44.5         | 32.5          | 28.4          |
| 31 | 100               | 6000      | 3.730           | 1.562           | 34.9          | 83.7          | 36.3          | 9.65     | 23.73        | 32.7          | 28.7          |
| 32 | 100               | 6000      | 4.178           | 1.355           | 23.7          | 79.0          | 46.9          | 3.36     | 18.1         | 35.0          | 30.3          |
| 33 | 110               | 6600      | 1.700           | 1.116           | 21.3          | 52.0          | 15.2          | 7.35     | 13.08        | 22.4          | 19.2          |
| 34 | 113               | 6780      | 3.331           | 1.110           | 24.2          | 82.7          | 22.5          | 10.42    | 32.51        | 33.3          | 28.1          |
| 35 | 117               | 7020      | 3.333           | 0.471           | -6.7          | 98.1          | 18.0          | 3.32     | 37.01        | 31.8          | 26.6          |
| 36 | 119               | 7140      | 3.333           | 0.381           | -12.9         | 108.0         | 16.7          | 1.97     | 38.31        | 31.9          | 26.6          |
| 37 | 120               | 7200      | 2.618           | 0.224           | -23.7         | 99.0          | 16.1          | 1.62     | 28.89        | 26.0          | 22.4          |

压缩机匹配实验

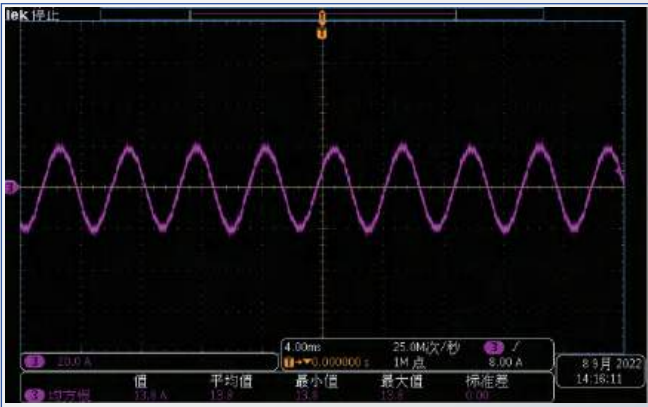
Compressor Matching Test

压缩机运行曲线精准匹配，深度匹配。

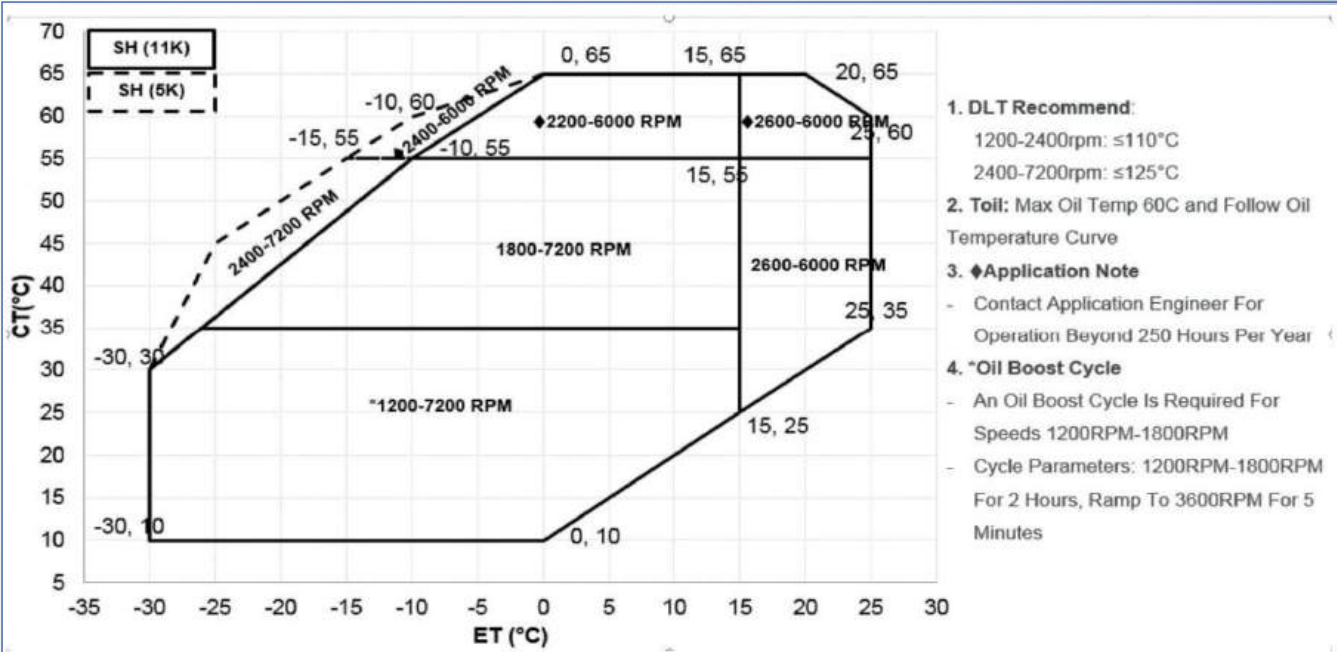
Precise and In-depth Matching of Compressor Operation Curves》



启动图  
Start-up Diagram



波形图  
Waveform Diagram



运行范围图  
Operating Range Diagram



Laboratory

# 实验室研发测试设备

R&D Test Equipment



美国Pacific 高精度  
程控测试电源  
Pacific high-precision programmable  
test power supply



日置温度记录仪  
Hioki temperature recorder



八通道高精度高清示波器  
8-channel high-precision high-definition oscilloscope



日立高低温试验箱  
Hitachi high and low temperature test chamber



Laboratory

# 实验室研发测试设备

R&D Test Equipment



同惠LRC测试仪  
Tonghui LRC tester



泰克高精度混合信号示波器  
Tektronix high-precision mixed signal oscilloscope



固纬高精度电子负载  
GWinstek high-precision electronic load



压缩机匹配测试台  
Compressor matching test bench