

MARS Series One Color Infrared Pyrometer

Operator's Manual



Changzhou Sijie Optoelectronics Technology Co.,Ltd.

Add: No.143, Qingyang N Road, Tianning, Changzhou, Jiangsu

Http://www.sjgdkj.com E-mail:ibd@sjgdkj.com

TEL:0519-85506598 FAX:0519-85851960

CONTENTS

1.1 Overview	1
1.2 Product Feature	1
1.3 Principle of one color infrared pyrometer	2
1.4 Application occasion	4
1.5 Technical parameters	5
1.5.1 MARS-S Technical parameter	5
1.5.2 MARS-G technical parameter	6
1.6 Wiring table	7
2.1 Installation and debugging	7
2.1.1 Installation	7
2.1.2 Debugging	1 0
2.1.2.1 Emissivity coefficient adjustment	1 0
2.1.2.2 Select Measure Mode	1 4
2.1.2.3 Setting alarm value(upper limit alarm , lower limit alarm), analog output starting value, Ending value etc.	1 4
3.1 Keyboard function definition	1 4
3.2 Keystroke operation process	1 4
3.2.1 One color emissivity coefficient	1 8
3.2.2 Display temperature range	1 8
3.2.3 Response time	1 9
3.2.4 Detection mode setting	1 9
3.2.5 LED aiming light turn On/Off status	2 0
3.2.6 Upper limit alarm and lower limit alarm	2 1
3.2.7 Upper limit and lower limit alarm dead zone	2 1
3.2.8 Analog output starting value and end value	2 1
3.2.9 Communication address	2 2
3.2.10 Communication baud rate	2 2
3.2.11 Test status	2 2
4.1 RS485 Communication agreement	2 2
4.1.1 command format	2 2
4.1.2 Address code	2 2
4.1.3 Operation code	2 3
4.1.4 Calibration code	2 4
5.1 Instrument calibration	2 5
5.1.1 Manufacturer's Calibration Environment and Conditions	2 5
5.1.2 Calibration Parameter Setting	2 5
5.1.3 Calibration Standards	2 6
5.1.4 Keypad Setting	2 6
5.2 Model definition	2 6
5.3 Notes and matters	2 7
6.1 Mars serie Outside drawing of MARS series one color infrared pyrometer	2 7
6.1.1 Movement outside drawing	2 7
6.1.2 Double angle adjustment bracket with purge jacket	2 8
6.1.3 With water jacket and purge jacket	2 9

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Operator's Manual

1.1 Overview

MARS series one color pyrometer is a high-performance, intelligent, one color infrared pyrometer with compact structure and powerful functions. It has a firm shell, 304 stainless steel movement (movement diameter is only 50mm), can be optional equipped with 304 stainless steel protective water jacket which has air purge and cooling function. It use the manual adjustable focal lens, achromatic lens, high reliability circuit design (low temperature drift, fully digital measurement designing scheme, high integration SOC chip application, visualize OLED interface) and software design (ambient temperature compensation, real-time signal processing, abnormal signal processing, software code optimization of all kinds of application environment). These special designs allow MARS series one color pyrometer to be well used for a variety of demanding industrial applications and precise temperature controls.

The MARS series of one color pyrometer measure the temperature of an object by receiving the sum of the energy it emits in a narrow band. It adopts advanced software and hardware design, with super wide dynamic range and high stability.

It can be widely used in forging industry, heat treatment, induction heating, vacuum furnace, high temperature furnace, monocrystalline silicon, polycrystalline silicon and other industrial temperature measurement.

1.2 Product Feature

- ✧ Temperature range covering 200°C ~ 3000°C.
- ✧ Temperature measurement accuracy up to 0.5%.
- ✧ Repeat accuracy 2°C, Resolution 0.1°C.
- ✧ Response time 5ms ~ 99.99s adjustable.
- ✧ Manual adjustable focus lens, Standard focus distance 0.35m to infinity.
- ✧ Near focus distance 0.2m ~ 0.5m adjustable.
- ✧ Detector with PID constant control, with full-range temperature.

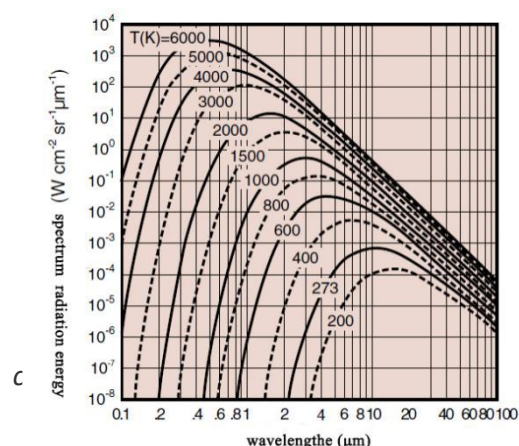
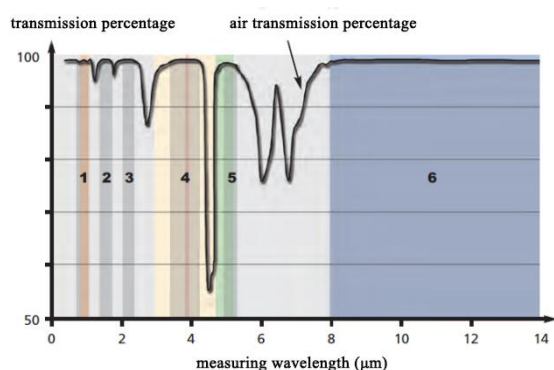


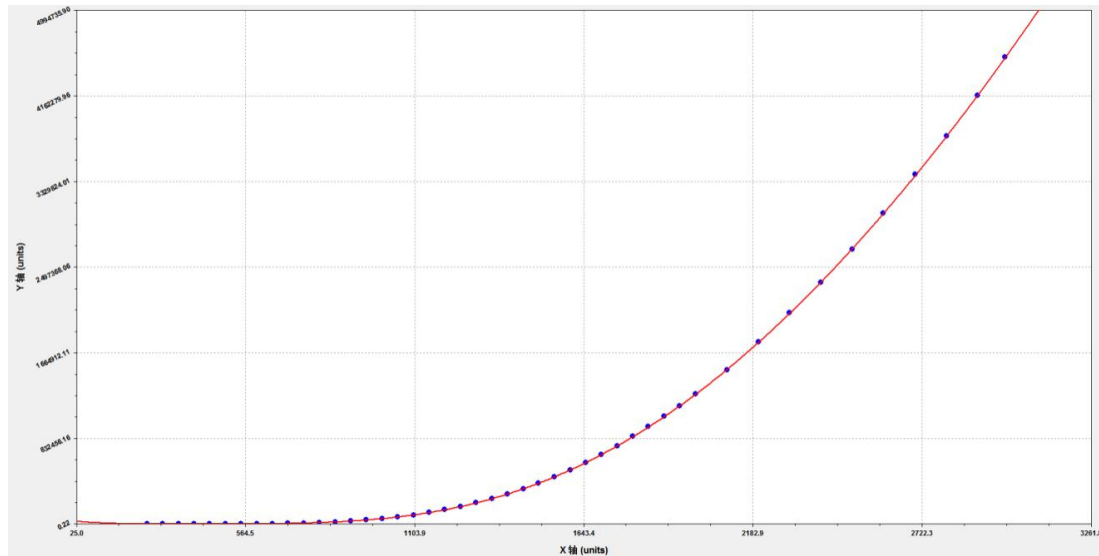
- ✧ Compensation, avoiding ambient temperature on measuring accuracy.
- ✧ Use industrial OLED screen as display interface.
- ✧ with friendly man-machine interface.
- ✧ Rich external interface: programmable 4 kinds of analog output options, 1 channel alarm output, 1 channel level output and 1 channel RS485 communication interface.
- ✧ Special design narrow band infrared color filter, to minimize detector's emissivity variation.
- ✧ The design of hardware and software watchdog and hardware EMI filtering can improve the system stability.
- ✧ Resistance to 2500VDC pulse group interference.
- ✧ Support thermometer bus cascade up to 26 sets, Via PC realize networked control.

1.3 Principle of one color infrared pyrometer

At present, one color pyrometers on the market are mostly narrow-band pyrometers. The principle of temperature measurement is to determine the temperature of an object by the amount of radiation energy occurring within a narrow wavelength range. With measuring an average temperature in an area, values is affected by emissivity, lens contamination and background radiation.

The amount of radiant energy emitted by an object is related to its emissivity. The higher the emissivity, the more infrared energy the object emits. The emissivity of an object is related to the state of the object surface. The surface roughness, the degree of brightness and darkness, and different materials all affect the emissivity. Therefore, when using a monochromatic pyrometer, there is often a table of emissivity of different materials.





250 ~ 3000°C InGaAs detector characteristic curve, signal dynamic range 2.1 million times

Changes in emissivity, lens contamination, and the effects of background radiation are related to the choice of wavelength. Choose special wavelength range can enable the one color pyrometer overcome the interference of transmission medium as much as possible. Such as the influence of water vapor, various gases and other substances. Choose short wavelength can minimize the influence of emissivity.

Different types of detector selected under different atmospheric

Window1	Si
Window2	Ge, InGaAs
Window3	PbS, ExInGaAs
Window4	PbSe, Thermopile
Window5	Thermopile
Window6	

1.4 Application occasion

The measuring area of the target object should be large (it can fully fill the target field of view), object surface should be relatively flat (not curved), measurement direction should less than 30 degrees, and the physical and chemical state of the measured object surface should be stable (not in the process of oxidation, gasification or liquefaction), the optical channel should with less dust and without blocking and attenuation.

1.5 Technical parameters

1.5.1 MARS-S Technical parameter

Model	MARS-S-6016	MARS-S-6022	MARS-S-7025	MARS-S-7030
Measuring range(°C)	600～1600	600～2200	700～2500	700～3000
Detector	Si(silicone photocell)			
Working wavelength	(0.85～1.1) μm			
Mostly application	Heat treatment, metal forging, casting,Induction heating, Glass, semiconductor		Induction heating, heat treatment, monocrystalline, polycrystalline, vacuum furnace, high temperature furnace	
Distance coefficient	100： 1		200： 1	
Measuring distance	Standard focus distance 0.35m to infinity adjustable , near focus distance 0.15m to 0.5m adjustable			
Measuring accuracy	±0.5%T°C(T as temperature measuring value)			
Temperature resolution	0.1°C			
Repeat accuracy	±2°C			
One-color coefficient	0.100～1.000 , Adjustable in 0.001 increments			
Response time	5ms～99.99s , capable adjustable			
Signal processing	Peak value, valley value, average temperature value; Ambient temperature too high/low alarm; power down protection.			
Output	Multiple analog output 16bit (4mA～20mA, 0mA～20mA, 0V～5V, 0V～10V option) Resolution 0.1°C , Current loop output maximum load 600Ω, Voltage output allowed current 10mA			
	Alarm output: Upper limit,Lower limit alarm , with photocouple relay has unlimited service life , On resistance≤1Ω, maximum allowed voltage: AC42V or DC60V , Maximum allowed current:100mA , Response time: 2ms			
	RS485 output , RS485 output,with functions of parameters modification, data logging and inquiry			
Display mode	With self-illumination industrial grade OLED display screen			
Power supply	DC(20～30)V , power consumption : 5W(24V@200mA) , With over voltage, over current, short circuit protection , With Built-in EMI filter,can resist 2500VDCpalus group interference.			
Ambient temperature compensation	Built-in ambient temperature compensation, almost unaffected by ambient temperature changes			
Aiming mode	Built-in visible high brightness green light or eyepiece aiming			
Interface	With fully sealed plug			
Service environment	Without water cooling:-20°C～+60°C With water cooling: -20°C～+200°C			
IP Grade	IP65			

1.5.2 MARS-G technical parameter

Model	MARS-G-2511	MARS-G-3014	MARS-G-3520	MARS-G-3525	MARS-EXG-2012 MARS-G-1508
Measuring range (°C)	250～1100	300～1400	350～2000	350～2500	200～1200 150～800
Detector	InGaAs (Indium gallium arsenic)				InGaAs (Extended Indium gallium arsenic)
Working wavelength	(1.45～1.7)μm				(1.45～2.1)um
Mostly application	Heat treatment, galvanized wire, nonferrous metal processing, annealing furnace		Induction heating,heat treatment, monocrystalline, polycrystalline, vacuum furnace, high temperature furnace		Nonferrous metal processing, induction heating, coating
Distance coefficient	60: 1	100: 1	200: 1		100: 1
Measuring coefficient	Standard focus distance 0.35m to infinity adjustable, near focusing distance 0.15m to 0.5m adjustable				
Measuring accuracy	±0.5%T°C (T as temperature measuring value)				
Temperature resolution	0.1°C				
Repeat accuracy	±2°C				
One-color coefficient	0.100～1.000, Adjustable in 0.001 increments				
Response time	5ms～99.99s, capable adjustable				
Signal processing	Peak value, valley value, average temperature value; Ambient temperature too high/low alarm; power down protection.				
Output	Multiple analog output 16bit (4mA～20mA, 0mA～20mA, 0V～5V, 0V～10V option) Resolution 0.1°C, Current loop output maximum load 600Ω, Voltage output allowed current 10mA				
	Alarm output: Upper limit, lower limit alarm, with photo-couple relay has unlimited service life.				
	On resistance≤1Ω, maximum allowed voltage: AC42V or DC60V, Maximum allowed current: 100mA, Response time: 2ms				
	RS485 output, capable parameter modification, data recording and query function				
Display mode	With self-illumination industrial grade OLED display screen				
Power supply	DC(20～30)V, power consumption: 5W(24V@200mA), With over voltage, over current, short circuit protection, With Built-in EMI filter,can resist 2500VDCpalus group interference.				
Ambient temperature compensation	Built-in ambient temperature compensation, almost unaffected by ambient temperature changes.				
Aiming mode	Built-in visible high brightness green light or eyepiece aiming				
Interface	With fully sealed plug				
Service environment	Without water cooling:-20°C～+60°C With water cooling: -20°C～+200°C				
IP rate	IP65				

1.6 Wiring table

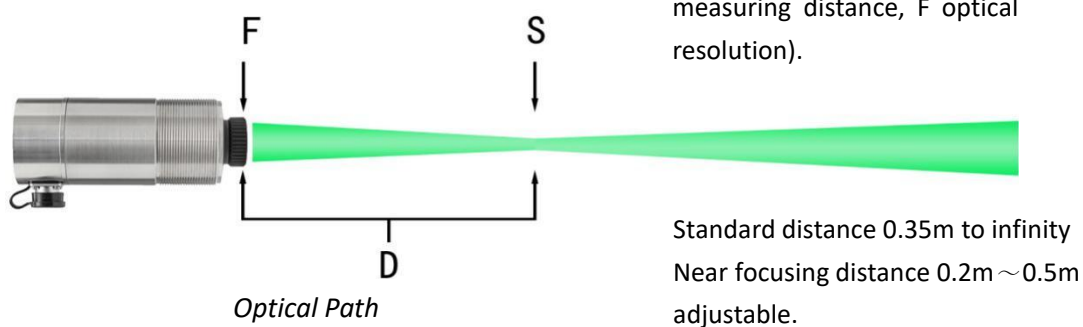
Brown	Red	Orange	Yellow	Green	Blue	Purple	Gray	Silver
1	2	3	4	5	6	7	8	9
+24V	0V	Analog+	Analog-	RS485+	RS485-	COM	NO	Shield
Power input		Analog output		RS485 Communication		Alarm output		Shielding layer

Multiple Analog Output: (4 ~ 20)mA, (0 ~ 20)mA, (0 ~ 5)V, (0 ~ 10)V alternative, default (4 ~ 20)mA. PNP output is dirty lens alarm output. Analog output and input power are isolated from each other. RS485 is isolate from input power.

2.1 Installation and debugging

2.1.1 Installation

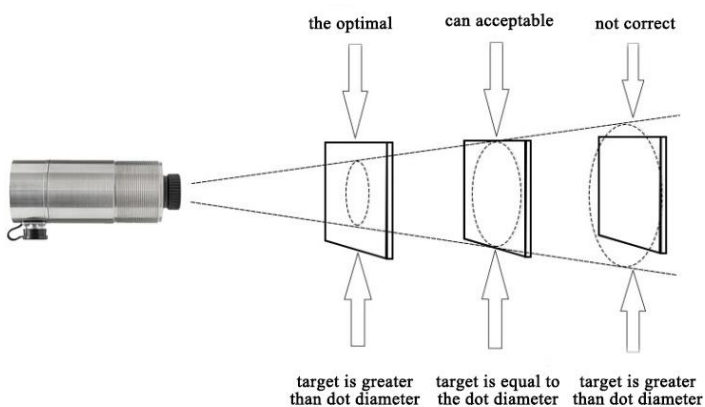
1. Overview



D(m)	0	0.2	0.35	0.5	1	1.5	2	3
S1(mm)	13	8	6	8	16	25	32	50
S2(mm)	13	7	3.5	5	10	15	20	30
S3(mm)	13	4	1.75	2.5	5	7.5	10	15

Standard focus distance

S1 corresponding F=60:1
S2 corresponding F=100:1
S3 corresponding F=200:1



Adjust the lens focus to make image clear. LED aiming light will indicate the size and position of the target. The installation distance is determined mainly by the size of the measured object. For example, the target is 10mm, and distance coefficient of the instrument $D/S=100:1$, $10\text{mm} \times 100 = 1000\text{mm}$, and the installation distance is required to be $\leq 1000\text{mm}$.

One color temperature measuring mode is used to measure the average temperature in an area. The focusing distance of the instrument can be adjusted for easy installation.

One color mode is suitable for measure below object: surface is relatively flat (not curved), and the measurement direction is less than 30°, surface physical and chemical state of the is stable (not in the process of oxidation, vaporization, and liquefaction), and the optical channel should with less dust and without blocking and attenuation. When the background temperature is higher than the measured temperature , the temperature can also be measured in the one color mode.

One color mode is used to measure large objects. Before measurement, make sure object can completely cover the field of view. Generally, object size should be greater than 20% of the field of view.

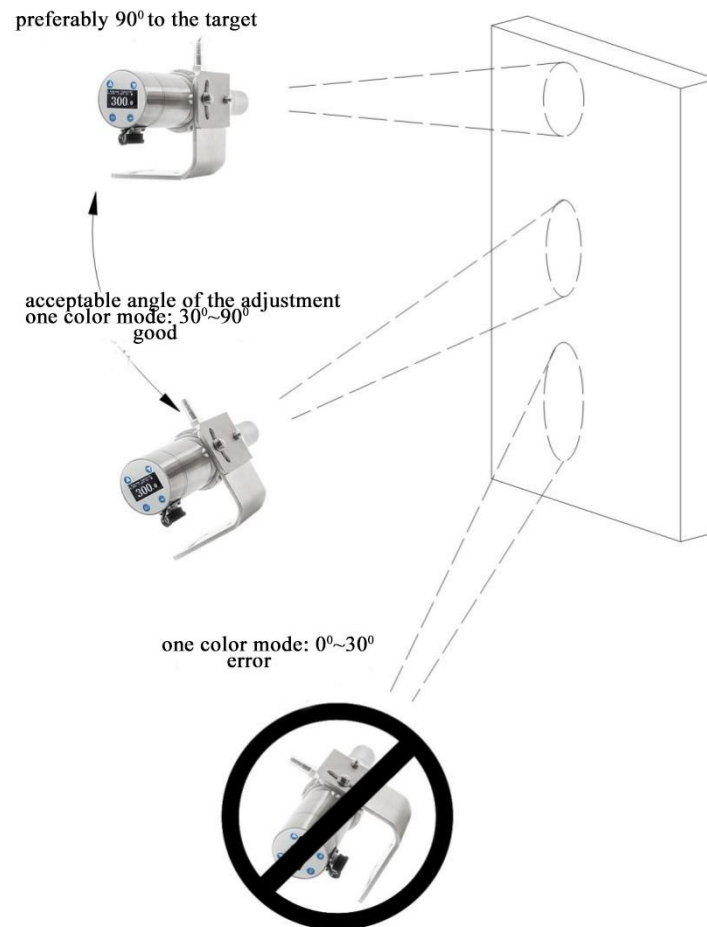
2. Aiming mode

Make the green LED light source or eyepiece just in the center of the detection target. Turn on and off can be controlled by keyboard. Adjust the focal length of the lens to get the clearest image. **Focal length can be adjusted by loosening the lens counterclockwise. When adjusted to a certain position, adjusting lens clockwise can lock the lens and seal it .**

When the distance is too close or too far, the LED light source can not be adjusted to clearest status. Pull the lens out to the top and measurement distance is the closet. Return the lens back to the end, the measurement distance is the farthest.

Light-reduce film (optional) can be added the end of the eyepiece. If the target temperature is below 1200°C, use can choose to add or not to add a light-reduce film. If the target temperature exceeds 1200°C, its necessary add a light-reduce film to prevent the damage of strong light to user eyes.

3. Angle of installation



4. Installation position selection

Pyrometer should be avoided to be installed directly above heat source and directly exposure to water vapor, or fumes. If harsh ambient environment is unavoidable, an air purge and other protective covers should be equipped.

5. Air purge and water cooling device

In order to measuring the temperature accurately, the lens components could be kept clean by using an air purge. When the ambient temperature is higher than 60°C, a water cooling jacket, works by water cooling or vortex refrigeration, should be installed on the instrument controller, to keeping the instrument in lower temperature.

6. Electrical connections

Connect electrical according to the requirement; choose shielded cable as connection cable; AC power supply equipment should be configured with voltage converter. In applications of severe power interference, such as medium frequency furnace, high frequency furnace, induction heating, etc., the power supply of the

instrument should avoid mixing with the power supply, and clean power supply should be used to supply power to the instrument.

The plug and socket are connected by plug-in structure, not threaded mode. There is a red mark in the connecting plug, push the plug and socket along the red mark and push the plug to the end. If the needle in the socket is bent or recessed due to incorrect connection, pliers may be used to pull the needle out or restore it to its original position.

2.1.2 Debugging

2.1.2.1 Emissivity coefficient adjustment

Emissivity means the heat radiation efficiency of the measured target surface. In practice almost all the emissivity of measured material surface are below 1.000. To make the measurement closer to the real temperature, the emissivity of the instrument should be modified to equal to or close to the actual emissivity of the material being measured. If the emissivity value of the instrument is greater than the actual emissivity of tested material, the measured temperature value will be lower than the real temperature value. Since it is very difficult to obtain the actual emissivity of some tested materials, the measurement is actually a relative temperature measurement.

The reason the emissivity of many of the materials in the table is not a fixed value is because they have different surface finishes. The emissivity of unoxidized metals increases markedly with slight contamination or oxidation on the surface.

The above common material emissivity is for reference only. The monochromatic emittance coefficient of a more accurate object is regulated as follows:

An RTD thermal resistor or thermocouple can detect the true temperature of the object and then adjust the emissivity setting until the displayed value of the thermometer equals with the true temperature of the measured object.

The emissivity coefficient can be up to 0.98 if part of the surface is coated with dark paint. Measure the adjacent areas of the object, and adjust the emissivity setting until the same temperature. At this time, the set value is the correct emissivity of the measured object.

The emittance table of monochromatic materials, shown in the following table:

Materials and Conditions	Temperature Range(°C)	Emissivity(1μm nearby)
Steel : Polished unoxidized Polished slightly oxidation Rough process without oxidation Rough process slightly oxidation Severe oxidation Liquid	100 ~ 1200	0.05 ~ 0.1 0.45 0.25 ~ 0.35 0.5 ~ 0.6 0.8 ~ 0.95 0.35 ~ 0.45
Cast iron : Polished unoxidized Polished slightly oxidation Rough process without oxidation Rough process slightly oxidation Severe oxidation Liquid	100 ~ 1200	0.3 0.5 0.5 0.75 0.8 ~ 0.95 0.35 ~ 0.4
Stainless steel : Smooth surface Oxidation over 800°C	room temperature ~ 800	0.2 ~ 0.25 0.85
copper : Smoothness slightly oxidation Severe oxidation Liquid	100 ~ 1000 100 ~ 1000	0.5 0.8 0.15 ~ 0.20
Iridium		0.25 ~ 0.3
Uranium		0.5 ~ 0.55
Mercury(liquid)		0.2 ~ 0.25
Cobalt : Polished unoxidized Polished slightly oxidation Polished severe oxidation Rough process without oxidation Rough process slightly oxidation Rough process severe oxidation	100 ~ 1000	0.25 0.5 0.7 0.35 0.55 ~ 0.6 0.7 ~ 0.75
Nickel and its coating : Polished unoxidized Polished slightly oxidation Polished severe oxidation Rough process without oxidation Rough process slightly oxidation Rough process severe oxidation	100 ~ 1000	0.25 0.4 0.8 ~ 0.9 0.35 0.5 0.8 ~ 0.9
Black nickel oxide	500 ~ 1000	0.8 ~ 0.9
Bismuth		0.34

Silver and its coating: Rough process without oxidation Rough process slightly oxidation	100 ~ 900	0.1 ~ 0.25 0.15 ~ 0.35
Tungsten Strip polishing without oxidation (Tungsten with lamp)	1500 2000 3000	0.3 ~ 0.39 0.3 ~ 0.37 0.3 ~ 0.36
Magnesium: Polished unoxidized		0.1 ~ 0.2
Platinum : Polished unoxidized Polished slightly oxidation Polished severe oxidation Rough process without oxidation Rough process slightly oxidation Rough process severe oxidation Platinum black	50 ~ 1000	0.25 0.3 0.4 0.3 0.4 0.4 ~ 0.5 0.95
Tantalum : Polished unoxidized Polished slightly oxidation Polished severe oxidation Rough process without oxidation Rough process slightly oxidation Rough process severe oxidation	100 ~ 1000	0.2 0.45 0.75 ~ 0.85 0.3 0.6 0.75 ~ 0.85
Palladium		0.33
Antimony		0.5 ~ 0.65
Beryllium : Smoothness oxidation		0.3 ~ 0.4
Brick : White firebrick Silica brick	100 ~ 1000 1000	0.3 0.5 ~ 0.6
Yttrium		0.3 ~ 0.35
Alumina Particle size 1 ~ 2 micron Particle size 10 ~ 100 micron	200 ~ 1000 1000 ~ 1500	0.2 ~ 0.4
Nickel-chromium iron alloy : (Nickel-chromium heat resistant alloy) Polished unoxidized Polished slightly oxidation Polished severe oxidation Rough process without oxidation Rough process slightly oxidation Rough process severe oxidation	0 ~ 1000	0.3 0.4 0.8 ~ 0.9 0.35 ~ 0.4 0.6 0.8 ~ 0.9
Carbon Carbon black Graphite	0 ~ 1500 0 ~ 1500 0 ~ 1500	0.8 ~ 0.85 0.95 0.8

Metallic material emissivity, wavelength 1.6μm

Material	Metal emissivity
Aluminum	
Not oxidized	0.02-0.2
Oxidized	0.4
Aluminium alloy A3003, Oxidized	0.4
Rough	0.2-0.6
Grinded	0.02-0.1
Brass	
Grinded	0.01-0.05
Polished	
Oxidized	0.6
Chromium	0.4
Copper	
Grinded	0.03
Rough	0.05-0.2
Oxidized	0.2-0.9
Gold	0.01-0.1
Hastelloy alloy	
Alloy	0.6-0.9
Inconel alloy	
Oxidized	0.6-0.9
Sandblast	0.3-0.6
Electro-polished	0.25
Iron	
Oxidized	0.5-0.8
Not oxidized	0.1-0.3
Rusted	0.6-0.9
Molten	0.4-0.6
Cast iron	
Oxidized	0.7-0.9
Not oxidized	0.3
Molten	0.3-0.4
Wrought iron	
Dark color	0.9

Material	Metal emissivity
Lead	
Grinded	0.05-0.2
Rough	0.6
Oxidized	0.3-0.7
Magnesium	0.05-0.3
Mercury	0.05-0.15
Molybdenum	
Oxidized	0.4-0.9
Not oxidized	0.1-0.35
Monel copper – nicke alloy	0.2-0.6
Nickel	
Oxidized	0.4-0.7
Electrolysis	0.1-0.3
Platinum	
Black	0.95
Sliver	0.02
Steel	
Cold rolled steel	0.8-0.9
Polished steel plate	0.25
Molten steel	0.25-0.4
Oxidized	0.8-0.9
Stainless Steel	0.2-0.9
Tin (not oxidized)	0.1-0.3
Titanium	
Grinded	0.3-0.5
Oxidized	0.6-0.8
Titanium	
Grinded	0.1-0.3
Zinc	
Oxidized	0.15
Grinded	0.05

2.1.2.2 Select Measure Mode

Real time temperature mode: Setup time 0.00s, Response time is 5ms

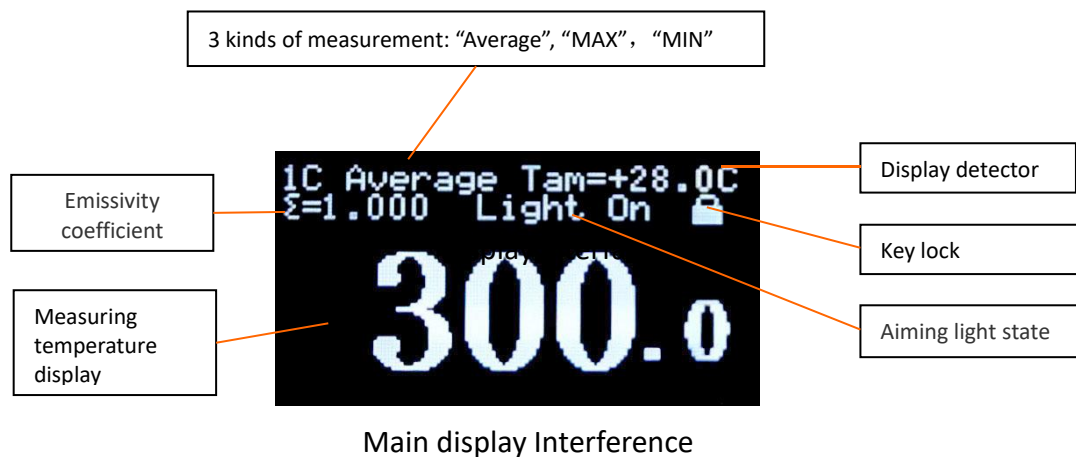
Peak temperature mode: Setup time 10ms ~ 99.99s, >99.90s temperature will remain unchanged.

Valley temperature mode: Setup time 10ms ~ 99.99s, >99.90s temperature will remain unchanged.

Average temperature mode: Setup time 5ms ~ 99.99s, Response time of average temperature is the time for signal to rise 95%, use first order RC Algorithm.

2.1.2.3 Setting alarm value(upper limit alarm, lower limit alarm), analog output starting value, Ending value etc.

3.1 Keyboard function definition



- "SET"key---Parameter setting button.
- "▲"key---Rise key, move the cursor key or continuously pressing up key to adjust the parameter.
- "▼"key---Down key, move the cursor key or continuously pressing down key to adjust the parameter.
- "↵"key---Identify key, identify each parameter setting.
- "Unlock key"--- Press "▼"key and "↵" key at the same time for 2s, to unlock keys.

3.2 Keystroke operation process

Continuous press "SET" key, display each parameter setting, press ▲ or ▼ key, can modify 1-14 item each parameter, press confirm key, Determines the current parameter value. Continuous press "SET" key, Display test status, Finally return to the main interface display, at the moment as the measurement status.

(1) MARS-S-6016 one color IR pyrometer

Menu	Function	Description	Default value	Key
Unlock	Key unlock	Press ▼ key and “OK”key 2s simultaneously, key to unlock. SET key function ON.	Key lock	▼ ↵
SET	Parameter setting	Continuously press SET key, setting parameter switch within 1 ~ 13, press “OK” key, determines the current parameter value. Press ▲ or ▼ key, move cursor's position, or modify each item parameter value. after modify the parameter, Press “OK” to move the next cursor.	Measurement status	SET ▲ ▼ ↵
1	One color coefficient	Emissivity adjustment range 0.100 ~ 1.000	0.995	▲▼
2	Display temperature range	Display C or F (C represent °C, F represent°F)	C	▲
3	Response time	Fastest response time in Sample Mode is 5ms, Setting range: 5ms ~ 99.99s	0.1s	▲▼
4	Detection mode	Sample Mode detection mode(MAX, Average, MIN) optional	Average	▲▼
5	Upper limit alarm	Upper Alarm setting range 600°C ~ 1600°C	1600°C	▲▼
6	Lower limit alarm	Lower Alarm setting range 600°C ~ 1600°C	600°C	
7	Upper and lower alarm dead zone	Dead Band setting range 0.000 ~ 0.500	0.001	▲▼
8	LED light turn on /off status	Light has 4 modes (On D,On N,Off D,Off N)	Off N	▲▼
9	Analog output starting value	Analog Start setting range 200°C ~ 1600°C	600°C	▲▼
10	Analog output end value	Analog End setting range 600°C ~ 1600°C	1600°C	
11	Communication baud rate	Baud Rate (4800,9600,19200,38400) optional	9600	▲▼
12	Communication address	RS485 communication address code, display address code A ~ Z	A	▲▼
13	Analog output	(4 ~ 20)mA, (0 ~ 20)mA, (0 ~ 5)V, (0 ~ 10)V optional.	(4 ~ 20)mA	▲▼
Test status	Detector parameter Test status	Display Tambient=+40C, 1C Big, 1C Small, 1CADJ, 1CZERO, information is use for test.		
Temperature measuring status	Return to the temperature measurement state	Refer to main interface display		

(2) MARS-G-3014 one color IR pyrometer

Menu	Function	Description	Default value	Key
Unlock	Key unlock	Press ▼ key and “OK” key simultaneously for 2s, unlock key. SET key function ON.	Key lock	
SET	Parameter setting	Continuously press SET key, setting parameter switch within 1~13, press “OK” key to determine the current parameter value. Press ▲ or ▼ key to move cursor's position or modify the parameters' value. After modify the parameter, press “OK” to move the next cursor.	Measuring status	SET  
1	Monochromatic emissivity coefficient	Emissivity adjustment range 0.100~1.000	0.995	▲ ▼
2	Display temperature range	Display C or F(C represent °C ,F represent °F)	C	▲
3	Response time	Fastest response time in Sample Mode is 5ms, Setting range: 5ms~99.99s	0.02s	▲ ▼
4	Detection mode	Sample Mode detection mode(MAX, Average, MIN) optional	Average	▲ ▼
5	Upper limit alarm	Upper Alarm setting range 300°C~1400°C	1400°C	▲ ▼
6	Lower limit alarm	Lower Alarm setting range 300°C~1400°C	300°C	
7	Upper and lower alarm dead zone	Dead Band setting range 0.000~0.500	0.001	▲ ▼
8	LED light turn on /off status	Light has 4 modes (On D,On N,Off D,Off N)	Off N	▲ ▼
9	Analog output starting value	Analog Start setting range 200°C~1400°C	300°C	▲ ▼
10	Analog output end value	Analog End setting range 300°C~2000°C	1400°C	
11	Communication baud rate	Baud Rate(4800,9600,19200,38400)optional	9600	▲ ▼
12	Communication baud rate	RS485 communication address code, display address code A~Z	A	▲ ▼
13	Analog output	(4~20)mA, (0~20)mA, (0~5)V, (0~10)V optional.	(4~20)mA	▲ ▼
Test status	Detector parameter test status	Display Tambient=+40C, 1C Big, 1C Small, 1CADJ, 1CZERO, information is use for test.		
Temperature measuring status	Return to the temperature measurement state	Refer to main interface display		

(3) MARS-S-6022 one color pyrometer parameter setting has below difference:

5	Upper limit alarm	Upper Alarm setting range 600°C ~ 2200°C	2200°C	▲▼
6	Lower limit alarm	Lower Alarm setting range 600°C ~ 2200°C	600°C	
9	Analog output start value	Analog Start setting range 600°C ~ 2200°C	600°C	▲▼
10	Analog output end value	Analog End setting range 600°C ~ 2200°C	2200°C	

(4) MARS-S-7025 one color pyrometer parameter setting has below difference:

5	Upper limit alarm	Upper Alarm setting range 700°C ~ 2500°C	2500°C	▲▼
6	Lower limit alarm	Lower Alarm setting range 700°C ~ 2500°C	700°C	
9	Analog output start value	Analog Start setting range 700°C ~ 2500°C	700°C	▲▼
10	Analog output end value	Analog End setting range 700°C ~ 2500°C	2500°C	

(5) MARS-S-7030 one color pyrometer parameter setting has below difference:

5	Upper limit alarm	Upper Alarm setting range 700°C ~ 3000°C	3000°C	▲▼
6	Lower limit alarm	Lower Alarm setting range 700°C ~ 3000°C	700°C	
9	Analog output start value	Analog Start setting range 700°C ~ 3000°C	700°C	▲▼
10	Analog output end value	Analog End setting range 700°C ~ 3000°C	3000°C	

(6) MARS-EXG-2012 one color pyrometer parameter setting has below difference:

5	Upper limit alarm	Upper Alarm setting range 200°C ~ 1200°C	1200°C	▲▼
6	Lower limit alarm	Lower Alarm setting range 200°C ~ 1200°C	200°C	
9	Analog output start value	Analog Start setting range 200°C ~ 1200°C	200°C	▲▼
10	Analog output end value	Analog End setting range 200°C ~ 1200°C	1200°C	

(7) MARS-G-2511 one color pyrometer parameter setting has below difference:

5	Upper limit alarm	Upper Alarm setting range 250°C ~ 1100°C	1100°C	▲▼
6	Lower limit alarm	Lower Alarm setting range 250°C ~ 1100°C	250°C	
9	Analog output starting value	Analog Start setting range 250°C ~ 1100°C	250°C	▲▼
10	Analog output end value	Analog End setting range 250°C ~ 1100°C	1100°C	

(8) MARS-G-3520 one color pyrometer parameter setting has below difference:

5	Upper limit alarm	Upper Alarm setting range 350°C ~ 2000°C	2000°C	▲▼
6	Lower limit alarm	Lower Alarm setting range 350°C ~ 2000°C	350°C	
9	Analog output starting value	Analog Start setting range 350°C ~ 2000°C	350°C	▲▼
10	Analog output end value	Analog End setting range 350°C ~ 2000°C	2000°C	

(9) MARS-G-3525 one color pyrometer parameter setting has below difference:

5	Upper limit alarm	Upper Alarm setting range 350°C ~ 2500°C	2500°C	▲▼
6	Lower limit alarm	Lower Alarm setting range 350°C ~ 2500°C	350°C	
9	Analog output starting value	Analog Start setting range 350°C ~ 2500°C	350°C	▲▼
10	Analog output end value	Analog End setting range 350°C ~ 2500°C	2500°C	

```

1C Average Tam=+28.0C
ε=1.000 Light On
300.0

```

```

1→Emissivity=1.000
2 Display C
3 Sample time=00.10s
4 Sample Mode
MAX
Average✓
MIN

```

```

5→Upper Alarm=1400C
6 Lower Alarm=0300C
7 Dead Baud =0.001
8 light On D✓
light On N
light Off D
light Off N

```

```

9 →Analog Start=0300C
10 Analog End=1400C
11 Baud Rate =
4800
9600 ✓
19200
38400
12 Address=A

```

```

13 Analog Output Mode
→4mA-20mA ✓
0mA-20mA
0V-5V
0V-10V

```

```

Tambient=+032C
1C Big =00000000
1CADJ =1.275
1CZERO =+0.00

INFORMATION IS
USE FOR TEST.

```

Press SET key to display each status information

3.2.1 One color emissivity coefficient

One color emissivity coefficient default value is 0.995, The black body emissivity of manufacture setting range is from 0.100 to 1.000, when emissivity ↑ 0.01 , display temperature will ↓ 1 to 2°C;

When do calibration, instrument emissivity coefficient will be adjusted equal to black body emissivity coefficient.

3.2.2 Display temperature range

Temperature show in C or F (C stands for °C, F stands for °F) , switch by▲key, default value is °C.

Conversion formula: Fahrenheit = (1.8× Celsius) +32

3.2.3 Response time

Real time temperature mode: Setup time 0.00s, Response time is 5ms.

Peak temperature mode : Setup time 5ms ~ 99.99s , >99.90s temperature will remain unchanged.

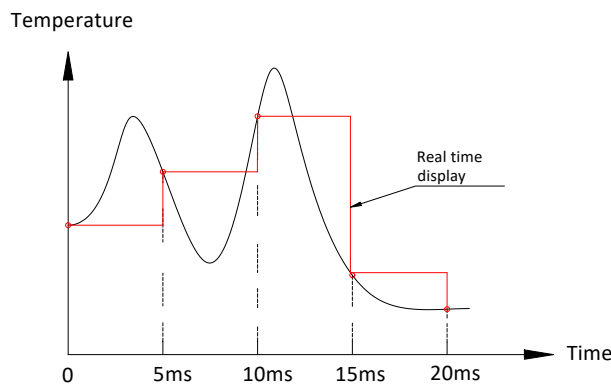
Valley temperature mode : Setup time 5ms ~ 99.99s, >99.90s temperature will remain unchanged.

Average temperature mode: Setup time 5ms~99.99s, response time of temperature is the time for signal to rise to 95%, use first order RC Algorithm.

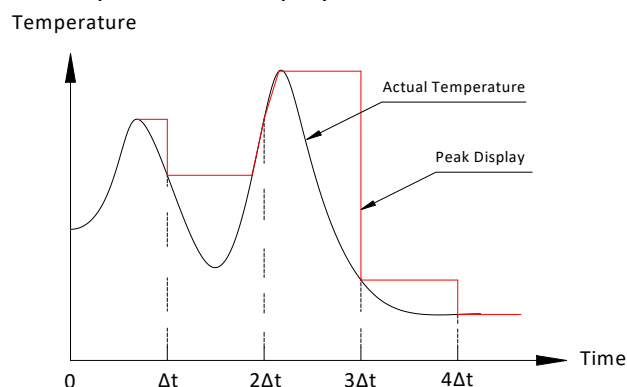
3.2.4 Detection mode setting

Sample Mode (real time display, MAX, Average, MIN) is optional.

(1) Real-time temperature measurement method



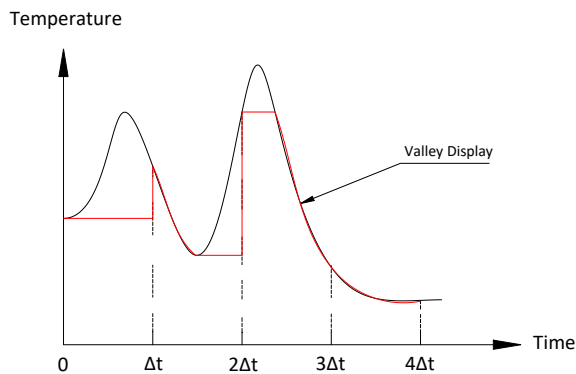
(2) Maximum temperature display mode or peak value display mode



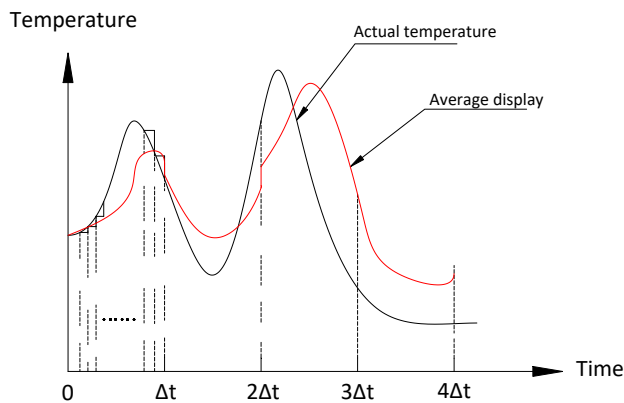
User can set the peak hold time by pressing the key. The instrument maintains and displays the maximum value of the real-time value within a selected time interval Δt .

Application: Suitable for fast moving targets. When measuring fast moving target, whose time passing through the detected area is very short, such as less than 0.1s, the maximum value of the temperature needs to be measured. This function can be used to obtain more accurate measurement. This function also be used to measure the temperature of metallic solution or liquid.

(3) Minimum temperature display mode or valley display mode



(4) Average temperature measurement method



User can set the average time by pressing key. The instrument calculates and displays the average value of real-time value in a selected time interval Δt . The first-order RC algorithm is used to reduce temperature fluctuations.

Application: The average temperature measurement method can reduce temperature fluctuations and improve the stability of the system. This mode is suitable for temperature measurement in most occasions.

3.2.5 LED aiming light turn On/Off status

LED aiming light has 4 modes (On D, On N, Off D, Off N) optional, default status is **On D**.

“Light On D” --- “On” means aiming light is forced on, “D” means when target temperature is higher than instrument lower limit temperature, then light will automatically on. Light will automatically turn off after 20mins, and status will switch to “Off D”.

“Light On N” --- “On” means aiming light is forced on. “N” means LED light status has no relationship with target temperature. Light will automatically turn off after 20mins, and status will switch to “Off N”.

“Light Off D”--- “Off” means aiming light is forced off. “D” means when target temperature is higher than instrument lower limit temperature, light will automatically turn off.

“Light Off N”--- “Off” means aiming light is forced off. “N” means LED light status has no relationship with target temperature.

3.2.6 Upper limit alarm and lower limit alarm

Upper limit alarm , When the alarm signal return difference is set to 0 , If temperature measurement > upper limit alarm , Corresponding upper limit relay and PNP signal from normally opening to closing state. Conversely, the corresponding upper limit relay and PNP signals are normally opening.

Lower limit alarm , When the alarm signal return difference is set to 0 , If temperature measurement < lower limit alarm , Corresponding lower limit relay and PNP signal from normally opening to closing state. Conversely, the corresponding lower limit relay and PNP signals are normally opening.

3.2.7 Upper limit and lower limit alarm dead zone

Dead Band setting range 0.000 ~ 0.500 , the factory default is 0.001. this function can be used to prevent alarm points shaking.

Dead zone refers to a temperature numerical area (including $\pm$) near the temperature measurement point. where the alarm signal and relay signal do not change the working state. Upper alarm dead zone = setting coefficient of alarm signal return difference * upper alarm value. Lower limit alarm dead zone range = setting coefficient of alarm signal return difference * lower limit alarm value.

3.2.8 Analog output starting value and end value

The analog output is voltage or current output. The starting value of analog output is **Analog Start**, the default value is the lower limit of the instrument. The end value of analog output is **Analog End**, the default value is the upper limit of the instrument.

There are two options of analog output, one is programmable 16bit output (4mA ~ 20mA, 0mA ~ 20mA, 0V ~ 5V, 0V ~ 10V optional), the other is 16bit output 4mA ~ 20mA, the calculation formula is as follows:

$$(4 \sim 20) \text{ mA output } I_{out} = 4 + [16(T_1 - T_2)] / T_3$$

$$(0 \sim 20) \text{ mA output } I_{out} = 20(T_1 - T_2) / T_3$$

$$(0 \sim 5) \text{ V voltage output } V_{out} = 5(T_1 - T_2) / T_3$$

$$(0 \sim 10) \text{ V current output } V_{out} = 10(T_1 - T_2) / T_3$$

T1 is the current displayed temperature, T2 is the temperature corresponding to Analog Start, and T3 is the difference between the temperature corresponding to Analog End and Analog Start.

3.2.9 Communication address

RS485 communication address code, display the address range A~Z, the default communication address is A. it can support instrument's communication up to 26 sets.

3.2.10 Communication baud rate

Communication baud rate(4800,9600,19200,38400)optional, the default value is 9600.

3.2.11 Test status

Display Tambint=+40C, 1C Big, 1C Small, 2C Ratio, the information is for testing purposes only.

4.1 RS485 Communication agreement

4.1.1 command format

<Start Bit> <Sensor Address> <Command Code> [<Value>] <Carriage Return>									
BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7	BYTE8	BYTE9	BYTE10
*	A to Z			X	X	X	X	X	
Starting code	Address code	Operation code 1	Operation code 2	Data code 1	Data code 2	Data code 3	Data code 4	Data code 5	Examine code

4.1.2 Address code

Specification: the starting code is always“*”; address code is 0~25 corresponding A~Z; operation code 1 and operation code 2 are combined as operation code.

4.1.3 Operation code

Command Command 1 Command 2	Command content (note: <CR> as examine code)
SD	One color and two color option *ASDx0000<CR> X= 1 one color temperature measurement, X=2 two color temperature measurement
SL	Two color slop rate *ASLxxxx<CR> xxxx: 0.850 ~ 1.150
SE	One color emissivity *ASExxxx<CR> xxxx: 0.100 ~ 1.000
SM	Temperature measurement mode setting :data code 1="P"sample peak; data code 1="V"sample valley; Data code 1="A"sample average; *ASMA0000<CR> average value measurement *ASMP0000<CR> peak value measurement *ASMV0000<CR> valley value measurement
RT	Temperature measurement mode time setting *ARTxx.xxx<CR> xxxx: for peaks and valleys, setting time range is: 00.00-99.99s,setting time is: 99.90 hold for infinity.for average,setting time range is: 00.00-60.00s.
DM	Display mode display unit: data code1=C, °C display; data code 1=F, °F display: *ADMC0000<CR> °C display *ADMF0000<CR> °F display
LU	Upper limit alarm, *ALUxxxx<CR> xxxx: 0600C/F~1600C/F
LD	Lower limit alarm, *ALDxxxx<CR> xxxx: 0600C/F~1600C/F
AS	Analog output starting temperature point, *AASxxxx<CR> xxxx: 0600C/F~1600C/F
AE	Analog output end temperature point, for example:*AAExxxx<CR> xxxx: 0600C/F~1600C/F
LS	LED light status, data code 1, 2, 3, 4 *ALS10000<CR> - LED light is timed on,detection temperature over lower limit value LED light turn on *ALS20000<CR> -LED light is timed on,unrelated with temperature *ALS30000<CR> -LED light is timed off,detection temperature over lower limit value LED light turn on *ALS40000<CR>-LED light is timed off, unrelated with temperature

PA	Display parameter *APA00000<CR>,Answer : *ASD2000d-----one color/two color temperature measurement *ASL1.000q-----one color emissivity / two color slop rate *ASMA0000- -----average value/peak value/valley value temperature measurement *ART00.01-----temperature measurement mode time *ADMCO000-----display unit C/F *ASF01.000-----one color fullness adjustment *ASO-0.00n-----one color zero compensation *ADF1.000l-----two color fullness adjustment *ADB0.001h-----alarm signal return difference setting coefficient *ALU1600C-----upper limit of detection temperature *ALD0600C-----lower limit of detection temperature *AAS0600C-----temperature corresponding to analog output starting value *AAE1600C-----temperature corresponding to analog output starting value *AOS10000-----analog channel option *ATO-0.00-----two color zero compensation *ALT0.950-----two color signal attenuation coefficient
DB	Alarm signal return difference setting coefficient *ADBxxxx<CR> xxxxx: 0.000 ~ 0.500
SF	One color fullness adjustment *ASF0xxxx<CR> xxx: 0.500—2.000
SO	One color zero compensation *ASOxxxx<CR> xxxxx: -1.00—+1.00
DF	Two color fullness adjustment, *ADFxxxx<CR> xxxxx: 0.500—1.300
DT	Display temperature, when the parameters are not modified, display currently measured temperature, *ADT00000<CR> Answer: one color temperature measurement *ADTxxxx C/F <CR>, two color temperature measurement*ADTxxxx C/F <CR> xxx: :0600—1600
DA	Display ambient temperature, for eample: *ADA00000<CR> Answer : *ADAxxxxC/F, xxx: -050--+100
BR	Baud rate option, For example: *ABRx0000<CR> x's value as follows: 0 = 4800 Baud, 1 = 9600 Baud, 2 = 19200 Band , 3 =38400 Baud
OS	Analog channel option, English name (Analog Output Select) , For example: *AOSx0000<CR> x's value as follows: 1 corresponding (4-20) mA,2 corresponding (0-20) mA,3 corresponding (0-5)V,4 corresponding (0-10)V
TO	Two color zero compensation, *ATOxx.xx<CR> , place in the calibration table xx.xx: -1.00—+1.00
LT	Two color signal attenuation coefficient, 2C signal attenuation ratio for example : *ALTx.xx0<CR> x.xx0: 0.200-1.000,the last digit is always 0

4.1.4 Calibration code

Examine code= BYTE2^ BYTE3^ BYTE4^ BYTE5^ BYTE6^ BYTE7^ BYTE8^ BYTE9

5.1 Instrument calibration

5.1.1 Manufacturer's Calibration Environment and Conditions

The ambient temperature is $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$, relative humidity is 35 ~ 75%, and atmospheric pressure is 86kPa ~ 106kPa. The low temperature section calibration adopts European and American blackbody furnace, which blackbody temperature control range is $200^{\circ}\text{C} \sim 1150^{\circ}\text{C}$, emission coefficient is ≥ 0.999 , diameter is 50mm. Use this blackbody furnace to calibrate temperature below 1000°C at a distance of one meter to blackbody surface. Mid-temperature section adopts European and American blackbody furnace, which blackbody temperature control range is $300^{\circ}\text{C} \sim 1700^{\circ}\text{C}$, emission coefficient ≥ 0.99 , diameter 25mm. Use this blackbody furnace to calibrate temperature within $1000^{\circ}\text{C} \sim 1600^{\circ}\text{C}$ at a distance of one meter to blackbody surface. High temperature section adopts European and American blackbody furnace, which blackbody temperature control range is $600^{\circ}\text{C} \sim 3000^{\circ}\text{C}$, emission coefficient ≥ 0.99 , diameter 25mm, Use this blackbody furnace to calibrate temperature within $1600^{\circ}\text{C} \sim 3000^{\circ}\text{C}$ at a distance of one meter to blackbody surface.



5.1.2 Calibration Parameter Setting

Power on the instrument for about 10 minutes to warm up. Record all the parameters in the setting key (manufacture parameters), restore the parameters to factory default values, and set the one-color mode emissivity coefficient to 0.990 or 1.000. Emissivity coefficient is determined by emissivity of blackbody. Set the two-color mode slope coefficient to 1.000, restore the parameters to factory default values and

record whether the indicators meet the requirements. After calibration, restore the manufacture parameters.

5.1.3 Calibration Standards

Referred industry standard: JB/T9240-1999 "Ratio Thermometer" . Referred calibration regulation: JJG 856-2015 "Radiation Thermometer for Work".

5.1.4 Keypad Setting

Press the setting key and corresponding function key glitter, and then press the ENTER key, display the current parameter value. Press the ▲ and ▼ keys to modify current parameter, and then press ENTER key to return to the temperature measurement state.

Press ▲ key to switch between two-color/one-color mode.

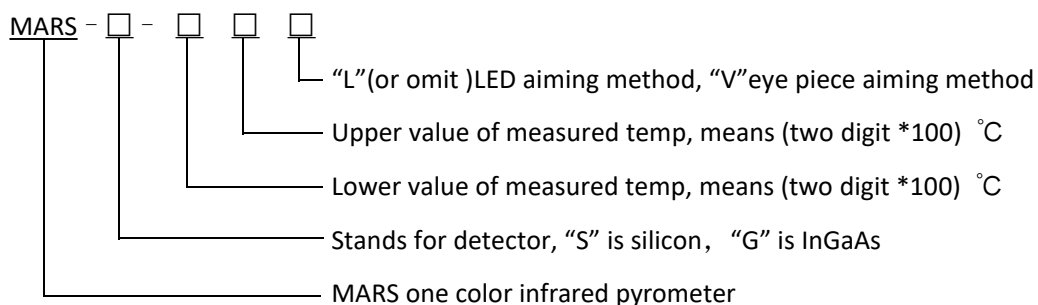
Coefficient setting , it is "2 Emissivity" coefficient setting in one-color mode, the default value is 0.995; and is "3 Slope" coefficient setting in the two-color mode, the default value is 1.000.

Detection mode "7 Sample Mode" , average temperature mode in "Average".

Response time "5 Sample time", response time is "0.10s".

Note: During calibration, only coefficient setting, detection mode, and response time need to be set, and other parameters do not need to be changed. During the test, power on for 10 minutes to warm instrument up, and then adjust lens focal length to ensure measurement target image clear, and the align LED light or eyepiece aiming ring with the center of the blackbody furnace to calibrate. Refer to verification regulations of JJG 856-2015 "Radiation Thermometer for Work".

5.2 Model definition



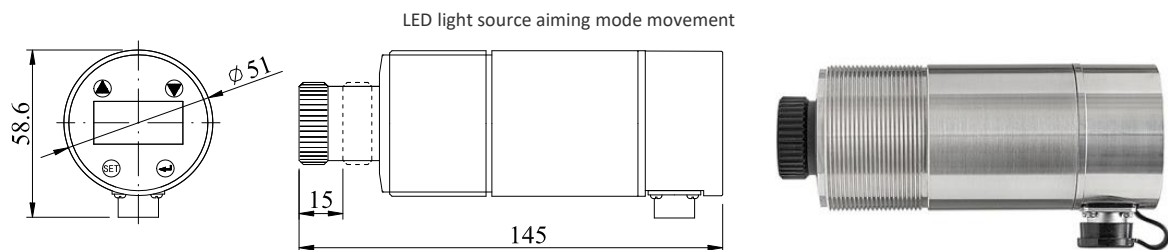
For example: MARS-S-6016, stands for a MRAS series one-color pyrometer whose measuring range is 600°C ~ 1600°C and detector is made of silicon. MARS-G-3514 stands for a MARS series one-color pyrometer whose measuring range is 350°C ~ 1400°C and detector is made of InGaAs.

5.3 Notes and matters

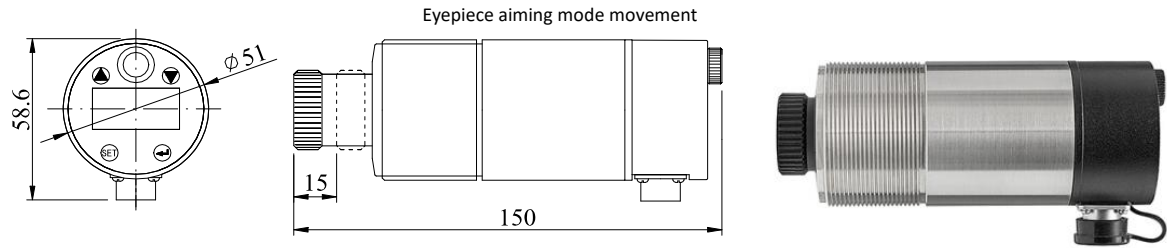
1. When using a pyrometer, the slope coefficient of the measured object must be determined, otherwise the measurement accuracy will be affected.
2. Strong shock and vibration should be avoided during transportation and use.
3. The infrared pyrometer is precisely calibrated before leaving the factory, please do not disassemble and adjust by yourself.
4. Smoke, dust and other pollutants in the air will affect the accuracy of pyrometer. Especially in one-color temperature measurement mode, the lens should be kept clean and dry. Clean lens regularly with lens paper or other soft materials.
5. Avoid installing the pyrometer probe directly above the measured object. When ambient temperature is high, it is better to add a cooling device; when installation environment is surrounded by water vapor, mist, and smoke, it is better to add an air purifier and other necessary protective cover.

6.1 Mars serie Outside drawing of MARS series one color infrared pyrometer

6.1.1 Movement outside drawing

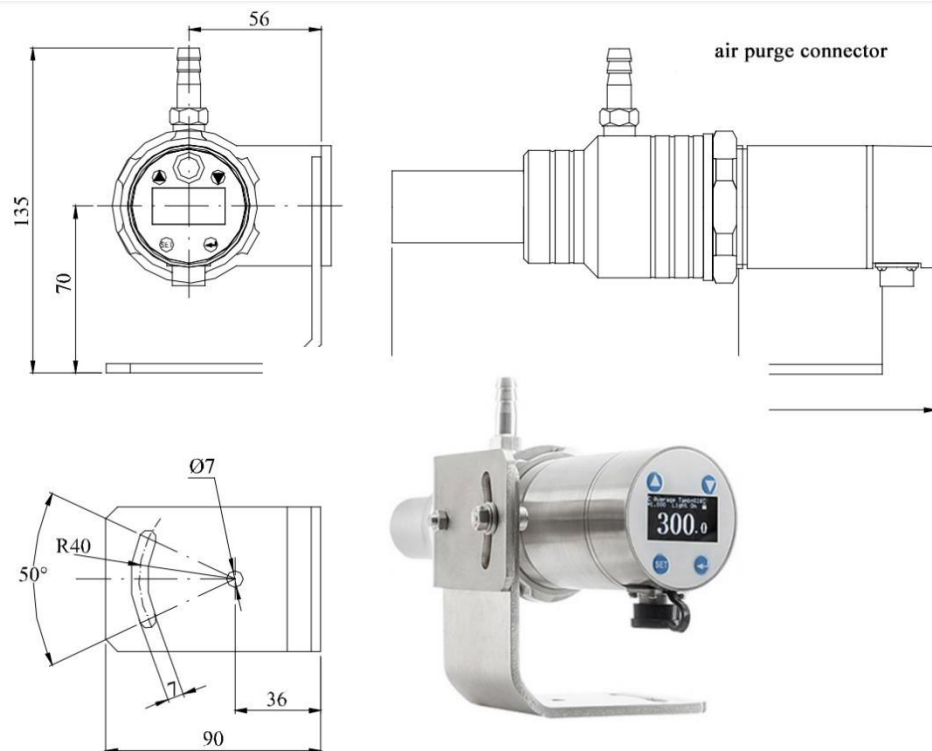


Using adjustable focus lens, LED green light aiming, light life up to 100,000 hours. 1:1 indicates the size of the measuring target. LED light sources are suitable for the detection of targets in close-distance installations (e.g., within 3m) and in non-enclosed environments.



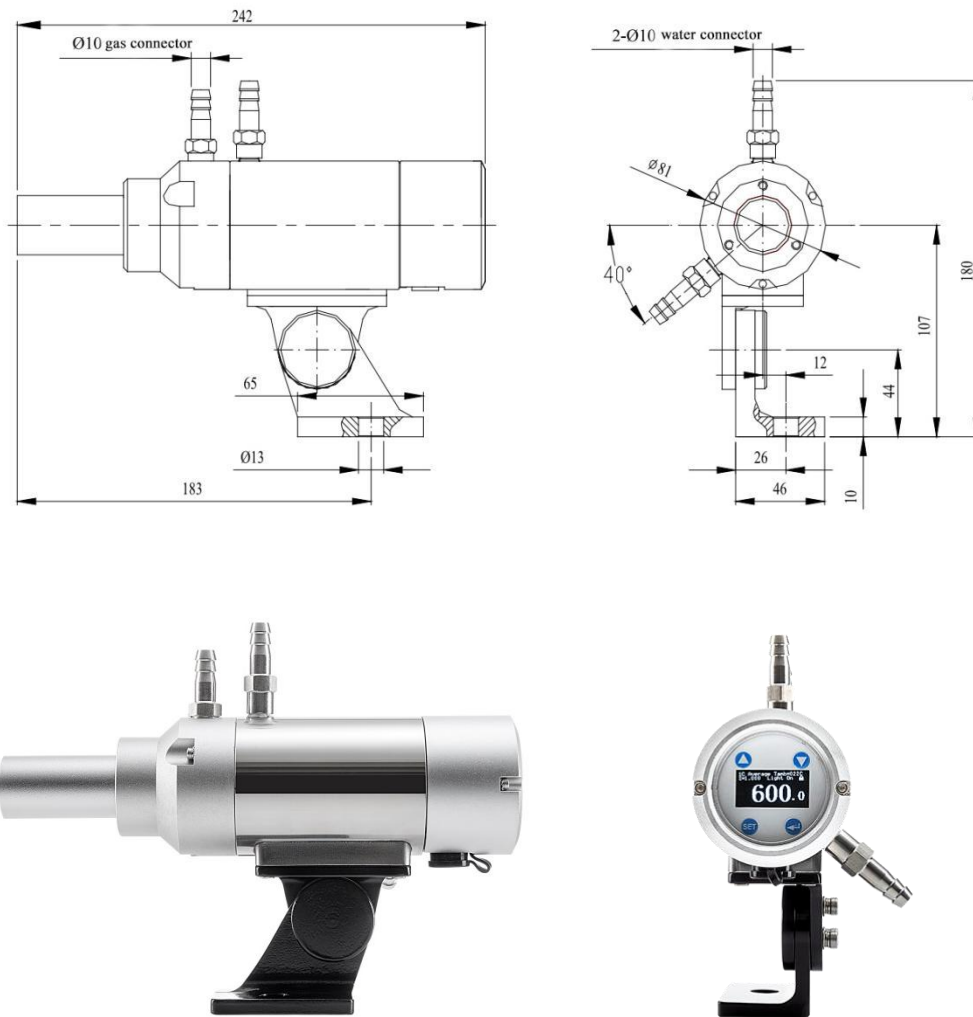
Using adjustable focus lens, visual aiming as positive, 1:1 indicates the size of the measured target, suitable for high temperature objects and closed environment and remote target detection.

6.1.2 Double angle adjustment bracket with purge jacket



The installation angle can be adjusted arbitrarily, with its own purge cover, it can effectively prevent dust, and it is suitable for use under the circumstance of low ambient temperature.

6.1.3 With water jacket and purge jacket



Equipped with purge and water cooling jacket, suitable for general occasions and under poor working conditions (dusty, high ambient temperature). For high safety or not suitable for water cooling, can use compressed air cooling or use eddy current refrigeration for cooling. the water cooled connector can also be installed with zG1/4 threaded connector.