Universidad Zaragoza
1542

Trabajo Final de Grado

CAMA TERMO-REGULABLE

THERMO-ADJUSTABLE BED

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Escuela Universitaria Politécnica La Almunia
2017

ESCUELA UNIVERSITARIA POLITÉCNICA

DE LA ALMUNIA DE DOÑA GODINA (ZARAGOZA)

ANEXOS

CAMA TERMO-REGULABLE

THERMO-ADJUSTABLE BED

424.16.102

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Fecha: 28-7-2017

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1.1.1. NTC

EPCOS

Temperature Measurement	B57861
Miniature Sensors, Close *B* Value Tolerance	S 861

Applications

- Heating systems
- Industrial electronics
- Automotive electronics

Features

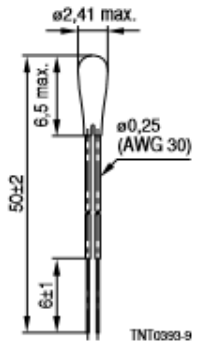
- Fast response
- High measuring accuracy, close *B* value tolerance
- Excellent long-term stability
- Epoxy resin encapsulation
- PTFE-insulated leads of silver-plated nickel wire, AWG 30

Options

Non-standard lead lengths

Delivery mode

Bulk



Dimensions in mm
Approx. weight 60 mg

Climatic category (IEC 60068-1)		40/100/56	
Max. power at 25 °C	P_{25}	60	mW
Resistance tolerance	$\Delta R_N/R_N$	± 1,0 %	
Rated temperature	T_N	25	°C
B value tolerance	$\Delta B/B$	± 0,3 %	
Dissipation factor (in air)	δ_{th}	approx. 1,5	mW/K
Thermal cooling time constant (in air)	τ_c	approx. 15	s
Heat capacity	C_{th}	approx. 22,5	mJ/K

R_{25} Ω	No. of *R/T* characteristic	$B_{25/100}$ K	Ordering code
5 k	8016	3988	B57861S0502F045
10 k	8016	3988	B57861S0103F045
30 k	8018	3964	B57861S0303F045

EPCOS

Temperature Measurement	B57861
Miniature Sensors, Close *B* Value Tolerance	S 861

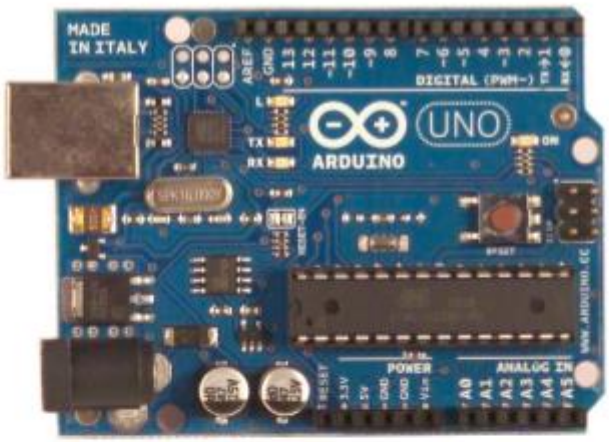
Reliability data

Test	Standard	Test conditions	$\Delta R_{25}/R_{25}$ (typical)	Remarks
Storage in dry heat	IEC 60068-2-2	Storage at upper category temperature *T*: 100 °C *t*: 1000 h	< 1 %	No visible damage
Storage in damp heat, steady state	IEC 60068-2-3	Temperature of air: 40 °C Relative humidity of air: 93 % Duration: 56 days	< 1 %	No visible damage
Rapid temperature cycling	IEC 60068-2-14	Lower test temperature: – 40 °C Upper test temperature: 100 °C Number of cycles: 100	< 1 %	No visible damage
Long-term stability (empirical value)		Temperature: 70 °C *t*: 10 000 h	< 2 %	No visible damage

1.2. PLACA CONTROLADORA

1.2.1. Arduino UNO

Arduino UNO



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Product Overview

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter.

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduno, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform; for a comparison with previous versions, see the index of Arduino boards.

Index

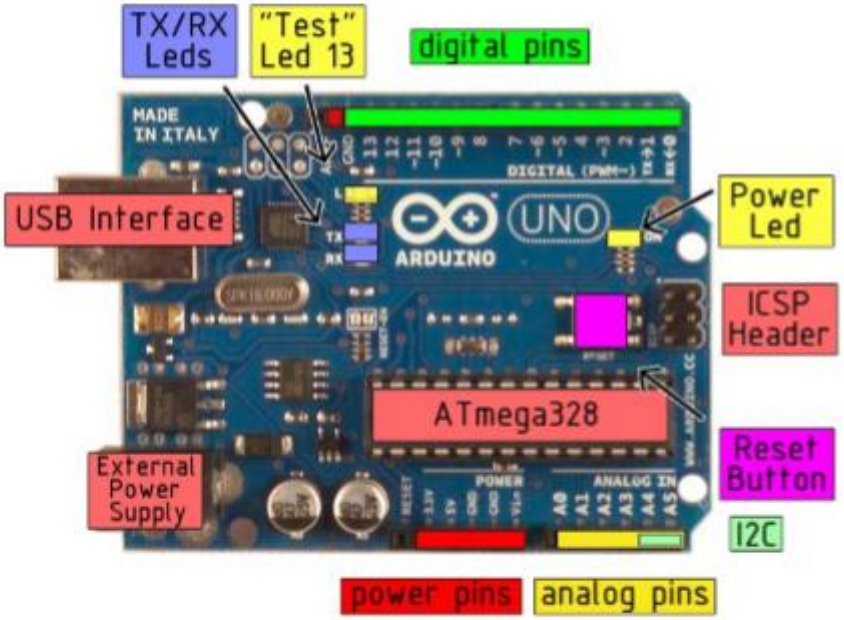
Technical Specification

EAGLE files: arduino-duemilanove-uno-design.zip Schematic: arduino-uno-schematic.pdf

Summary

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB of which 0.5 KB used by bootloader
SRAM	2 KB
EEPROM	1 KB
Clock Speed	16 MHz

the board



1.2.2. ATMega328

Features

- High Performance, Low Power AVR® 8-Bit Microcontroller
- Advanced RISC Architecture
  - 131 Powerful Instructions – Most Single Clock Cycle Execution
  - 32 x 8 General Purpose Working Registers
  - Fully Static Operation
  - Up to 20 MIPS Throughput at 20 MHz
  - On-chip 2-cycle Multiplier
- High Endurance Non-volatile Memory Segments
  - 4/8/16/32K Bytes of In-System Self-Programmable Flash program memory
  - 256/512/512/1K Bytes EEPROM
  - 512/1K/1K/2K Bytes Internal SRAM
  - Write/Erase Cycles: 10,000 Flash/100,000 EEPROM
  - Data retention: 20 years at 85°C/100 years at 25°C(1)
  - Optional Boot Code Section with Independent Lock Bits
    - In-System Programming by On-chip Boot Program
    - True Read-While-Write Operation
  - Programming Lock for Software Security
- Peripheral Features
  - Two 8-bit Timer/Counters with Separate Prescaler and Compare Mode
  - One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and Capture Mode
  - Real Time Counter with Separate Oscillator
  - Six PWM Channels
  - 8-channel 10-bit ADC in TQFP and QFN/MLF package
    - Temperature Measurement
  - 6-channel 10-bit ADC in PDIP Package
    - Temperature Measurement
  - Programmable Serial USART
  - Master/Slave SPI Serial Interface
  - Byte-oriented 2-wire Serial Interface (Philips I²C compatible)
  - Programmable Watchdog Timer with Separate On-chip Oscillator
  - On-chip Analog Comparator
  - Interrupt and Wake-up on Pin Change
- Special Microcontroller Features
  - Power-on Reset and Programmable Brown-out Detection
  - Internal Calibrated Oscillator
  - External and Internal Interrupt Sources
  - Six Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, Standby, and Extended Standby
- I/O and Packages
  - 23 Programmable I/O Lines
  - 28-pin PDIP, 32-lead TQFP, 28-pad QFN/MLF and 32-pad QFN/MLF
- Operating Voltage:
  - 1.8 - 5.5V
- Temperature Range:
  - -40°C to 85°C
- Speed Grade:
  - 0 - 4 MHz@1.8 - 5.5V, 0 - 10 MHz@2.7 - 5.5.V, 0 - 20 MHz @ 4.5 - 5.5V
- Power Consumption at 1 MHz, 1.8V, 25°C
  - Active Mode: 0.2 mA
  - Power-down Mode: 0.1 µA
  - Power-save Mode: 0.75 µA (Including 32 kHz RTC)

8-bit AVR® Microcontroller with 4/8/16/32K Bytes In-System Programmable Flash

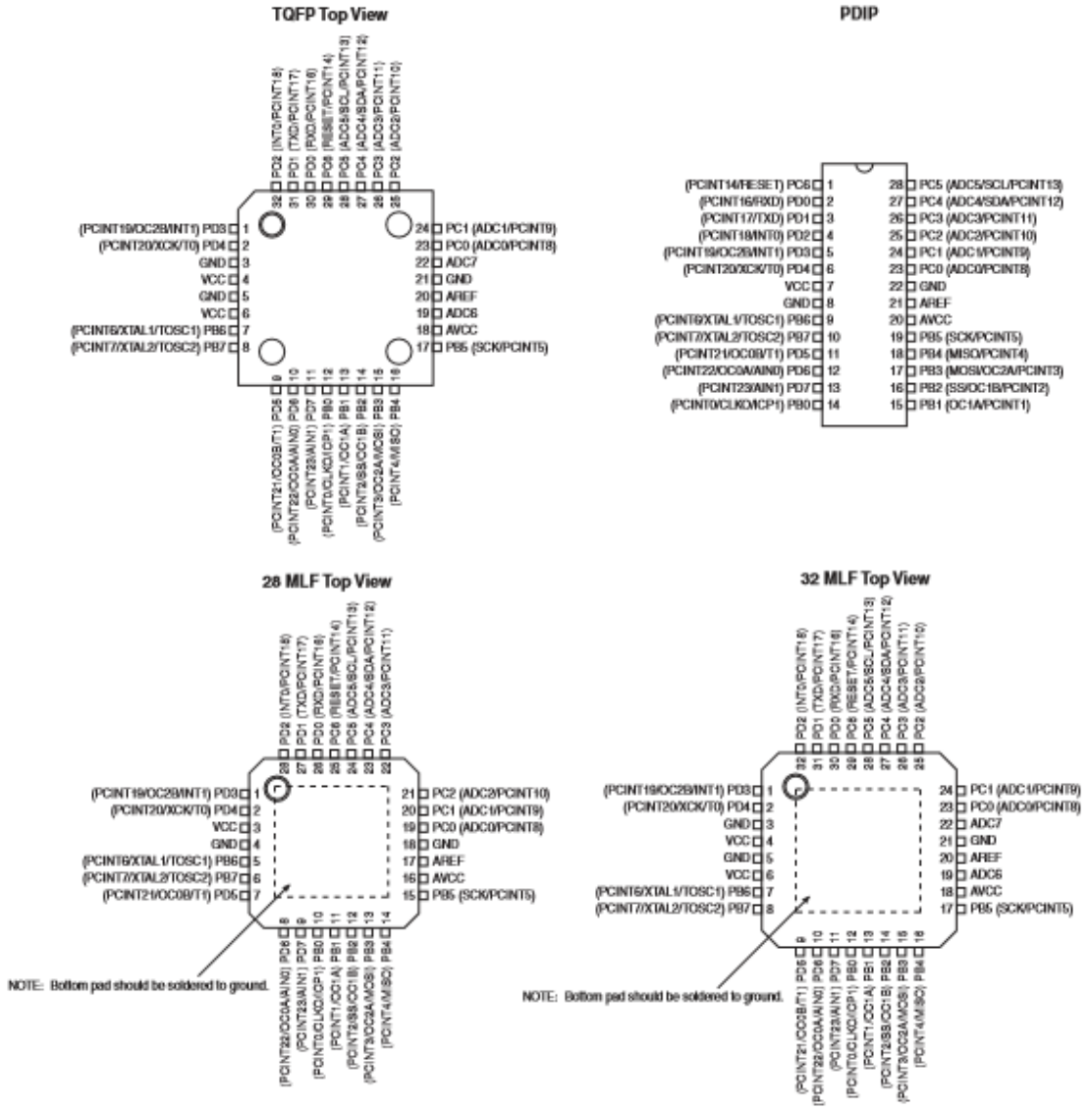
ATmega48A
ATmega48PA
ATmega88A
ATmega88PA
ATmega168A
ATmega168PA
ATmega328
ATmega328P

Summary

Rev. 8271BS–AVR–04/10

1. Pin Configurations

Figure 1-1. Pinout ATmega48A/48PA/88A/88PA/168A/168PA/328/328P



1.1 Pin Descriptions

1.1.1 VCC

Digital supply voltage.

1.1.2 GND

Ground.

1.1.3 Port B (PB7:0) XTAL1/XTAL2/TOSC1/TOSC2

Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port B output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated. The Port B pins are tri-stated when a reset condition becomes active, even if the clock is not running.

Depending on the clock selection fuse settings, PB6 can be used as input to the inverting Oscillator amplifier and input to the internal clock operating circuit.

Depending on the clock selection fuse settings, PB7 can be used as output from the inverting Oscillator amplifier.

If the Internal Calibrated RC Oscillator is used as chip clock source, PB7...6 is used as TOSC2...1 input for the Asynchronous Timer/Counter2 if the AS2 bit in ASSR is set.

The various special features of Port B are elaborated in and "System Clock and Clock Options" on page 26.

1.1.4 Port C (PC5:0)

Port C is a 7-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The PC5...0 output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The Port C pins are tri-stated when a reset condition becomes active, even if the clock is not running.

1.1.5 PC6/$\overline{\text{RESET}}$

If the RSTDISBL Fuse is programmed, PC6 is used as an I/O pin. Note that the electrical characteristics of PC6 differ from those of the other pins of Port C.

If the RSTDISBL Fuse is unprogrammed, PC6 is used as a Reset input. A low level on this pin for longer than the minimum pulse length will generate a Reset, even if the clock is not running. The minimum pulse length is given in Table 28-12 on page 323. Shorter pulses are not guaranteed to generate a Reset.

The various special features of Port C are elaborated in "Alternate Functions of Port C" on page 86.

1.1.6 Port D (PD7:0)

Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port D pins that are externally pulled low will source current if the pull-up resistors are activated. The Port D pins are tri-stated when a reset condition becomes active, even if the clock is not running.

The various special features of Port D are elaborated in "Alternate Functions of Port D" on page 89.

1.1.7 AV_{CC}

AV_{CC} is the supply voltage pin for the A/D Converter, PC3:0, and ADC7:6. It should be externally connected to V_{CC}, even if the ADC is not used. If the ADC is used, it should be connected to V_{CC} through a low-pass filter. Note that PC6...4 use digital supply voltage, V_{CC}.

1.1.8 AREF

AREF is the analog reference pin for the A/D Converter.

1.1.9 ADC7:6 (TQFP and QFN/MLF Package Only)

In the TQFP and QFN/MLF package, ADC7:6 serve as analog inputs to the A/D converter. These pins are powered from the analog supply and serve as 10-bit ADC channels.

1.3. ALIMENTACIÓN

1.3.1. Fuente de Alimentación

TRACO POWER

AC/DC Power Modules

TML Series, 20 & 40 Watt

CB Scheme CE LVD cULus UL 60950-1

Features

- Encapsulated power supplies with increased power density
- Replaces TML 15 and TML 30 series
- PCB mount or chassis mount with screw terminals
- Single, dual and triple output models
- Universal input 90–264 VAC, 47–440 Hz
- EMI meets EN 55022, class B and FCC, level B
- Protection class II for TML 40 models
- Short circuit and overload protection
- 3-year product warranty

Also see:
TMLM Series, 4 to 20 Watt
highest power density, PCB mount.
www.tracopower.com/products/tmlm.pdf

Referance datasheet for primary TML models, see:
www.tracopower.com/products/tml-primary.pdf
(not recommended for new design in)

The TML series are ultra compact AC/DC power supplies in a fully encapsulated plastic case. They feature versions with screw terminals for easy installation or with solder pins for direct PCB mounting. International safety approvals qualify this product for worldwide markets. The TML series AC/DC modules offer an interesting solution for many space critical applications in commercial and industrial electronic equipment.

20 Watt Models

Order code		Output power max.	Output 1	Output 2	Output 3
PCB mount	Chassis mount				
TML 20103	TML 20103C	14.9 W	3.3 VDC/4500 mA		
TML 20105	TML 20105C	20 W	5.0 VDC/4000 mA		
TML 20112	TML 20112C		12 VDC/1670 mA		
TML 20115	TML 20115C		15 VDC/1340 mA		
TML 20124	TML 20124C		24 VDC/840 mA		
TML 20205	TML 20205C		+5.0 VDC/2000 mA	–5.0 VDC/2000 mA	
TML 20212	TML 20212C		+12 VDC/833 mA	–12 VDC/833 mA	
TML 20215	TML 20215C		+15 VDC/667 mA	–15 VDC/667 mA	
TML 20512	TML 20512C		5 VDC/2800 mA	+12 VDC/250 mA	–12 VDC/250 mA
TML 20515	TML 20515C		5 VDC/2800 mA	+15 VDC/200 mA	–15 VDC/200 mA

TRACO POWER

AC/DC Power Modules

TML Series 20 & 40 Watt

40 Watt Models

Order code PCB mount	Order code Chassis mount	Output power max.	Output 1	Output 2	Output 3
TML 40103	TML 40103C	26.4 W	3.3 VDC/8000 mA		
TML 40105	TML 40105C	40 W	5.0 VDC/8000 mA		
TML 40112	TML 40112C		12 VDC/3333 mA		
TML 40115	TML 40115C		15 VDC/2666 mA		
TML 40124	TML 40124C		24 VDC/1667 mA		
TML 40205	TML 40205C		+5.0 VDC/4000 mA	–5.0 VDC/4000 mA	
TML 40212	TML 40212C		+12 VDC/1666 mA	–12 VDC/1666 mA	
TML 40215	TML 40215C		+15 VDC/1333 mA	–15 VDC/1333 mA	
TML 40252	TML 40252C		*5.0 VDC/5000 mA	*12 VDC/1250 mA	
TML 40254	TML 40254C		*5.0 VDC/5000 mA	*24 VDC/625 mA	
TML 40512	TML 40512C		*5.0 VDC/5000 mA	+12 VDC/600 mA	–12 VDC/600 mA
TML 40515	TML 40515C		*5.0 VDC/5000 mA	+15 VDC/500 mA	–15 VDC/500 mA

* Output floating

Input Specifications

Input voltage ranges	– AC input	90 – 264 VAC
	– DC input	100 – 375 VDC
Input frequency		47 – 440 Hz
Input current at full load (115 VAC / 230 VAC nominal input)	TML 20 models:	400 mA / 270 mA typ.
	TML 40 models:	860 mA / 460 mA typ
Leakage current		0.75 mA max.
External fuse (required)		1.5 A slow blow type (recommendation)

Output Specifications

Voltage set accuracy	TML 20 models:	±2 %
	TML 40 single and symetric dual output models:	±2 %
	TML 40 asymetric dual and triple output models:	±3 % for output 1, ±5 % for output 2&3
Minimum load	TML 20 single and dual output models:	0 %
	TML 20 triple output models:	10 % (each output)
	TML 40 single output models:	1 %
	TML 40 symetric dual output models:	10 % (each output)
	TML 40 asymetric dual and triple output models:	25 % (each output)
		operation at lower load condition will not damage these power supplies, however, they may not meet all listed specifications.
Ripple and noise (20 MHz bandwidth)	TML 20 models:	<0.7 % of Vout +90 mV [Vp-p]
	TML 40, 3.3 VDC model:	<50 mVp-p
	TML 40 other models:	<1 % of Vout [Vp-p]
Regulation – Input variation	single and symetric dual output models:	0.5 % (each output)
	TML 20 triple output models:	1 % for output 1, 5 % for output 2&3
	TML 40 asymetric dual and triple output models:	±0.5 % for output 1, ±5 % for output 2&3

All specifications valid at nominal input voltage, full load and +25°C after warm-up time unless otherwise stated.

1.4. CIRCUITO DE POTENCIA

1.4.1. MOSFETs

1.4.1.1. MOSFET-N

FAIRCHILD SEMICONDUCTOR

June 2009

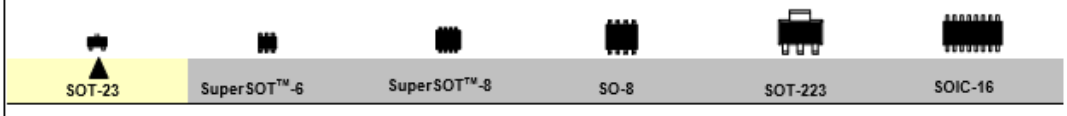
FDV301N
Digital FET , N-Channel

General Description

This N-Channel logic level enhancement mode field effect transistor is produced using Fairchild's proprietary, high cell density, DMOS technology. This very high density process is especially tailored to minimize on-state resistance. This device has been designed especially for low voltage applications as a replacement for digital transistors. Since bias resistors are not required, this one N-channel FET can replace several different digital transistors, with different bias resistor values.

Features

- 25 V, 0.22 A continuous, 0.5 A Peak.
  $R_{DS(ON)}$ = 5 Ω @ V_{GS}= 2.7 V
  $R_{DS(ON)}$ = 4 Ω @ V_{GS}= 4.5 V.
- Very low level gate drive requirements allowing direct operation in 3V circuits. $V_{GS(th)}$ < 1.06V.
- Gate-Source Zener for ESD ruggedness. >6kV Human Body Model
- Replace multiple NPN digital transistors with one DMOS FET.



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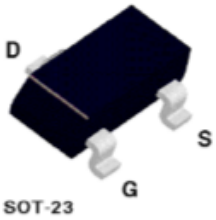
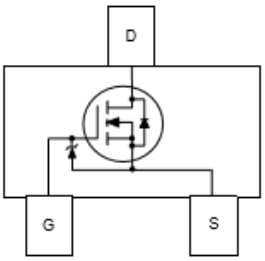
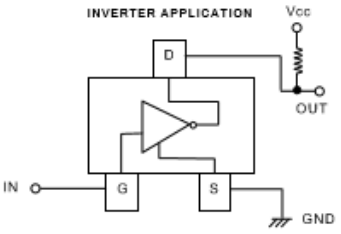






Absolute Maximum Ratings T_A = 25°C unless other wise noted

Symbol	Parameter	FDV301N	Units
V_{DSS}, V_{CC}	Drain-Source Voltage, Power Supply Voltage	25	V
V_{GSS}, V_I	Gate-Source Voltage, V_{IN}	8	V
I_D, I_O	Drain/Output Current - Continuous	0.22	A
		0.5	
P_D	Maximum Power Dissipation	0.35	W
T_J, T_{STG}	Operating and Storage Temperature Range	-55 to 150	°C
ESD	Electrostatic Discharge Rating MIL-STD-883D Human Body Model (100pf / 1500 Ohm)	6.0	kV
THERMAL CHARACTERISTICS			
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	357	°C/W

Inverter Electrical Characteristics (T_A = 25 °C unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
$I_{O(off)}$	Zero Input Voltage Output Current	V_{CC} = 20 V, V_I = 0 V			1	µA
$V_{I(off)}$	Input Voltage	V_{CC} = 5 V, I_O = 10 µA			0.5	V
$V_{I(on)}$		V_O = 0.3 V, I_O = 0.005 A	1			V
$R_{O(on)}$	Output to Ground Resistance	V_I = 2.7 V, I_O = 0.2 A		4	5	Ω

Electrical Characteristics (T_A = 25 °C unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
OFF CHARACTERISTICS						
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} = 0 V, I_D = 250 µA	25			V
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	I_D = 250 µA, Referenced to 25 °C		25		mV / °C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 20 V, V_{GS} = 0 V			1	µA
		T_J = 55°C			10	µA
I_{GSS}	Gate - Body Leakage Current	V_{GS} = 8 V, V_{DS} = 0 V			100	nA
ON CHARACTERISTICS (Note)						
$\Delta V_{GS(th)}/\Delta T_J$	Gate Threshold Voltage Temp. Coefficient	I_D = 250 µA, Referenced to 25 °C		-2.1		mV / °C
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = 250 µA	0.70	0.85	1.06	V
$R_{DS(ON)}$	Static Drain-Source On-Resistance	V_{GS} = 2.7 V, I_D = 0.2 A		3.8	5	Ω
		T_J =125°C		6.3	9	
		V_{GS} = 4.5 V, I_D = 0.4 A		3.1	4	
$I_{D(ON)}$	On-State Drain Current	V_{GS} = 2.7 V, V_{DS} = 5 V	0.2			A
g_{FS}	Forward Transconductance	V_{DS} = 5 V, I_D = 0.4 A		0.2		S
DYNAMIC CHARACTERISTICS						
C_{iss}	Input Capacitance	V_{DS} = 10 V, V_{GS} = 0 V, f = 1.0 MHz		9.5		pF
C_{oss}	Output Capacitance			6		pF
C_{rss}	Reverse Transfer Capacitance			1.3		pF
SWITCHING CHARACTERISTICS (Note)						
$t_{D(on)}$	Turn - On Delay Time	V_{DD} = 6 V, I_D = 0.5 A, V_{GS} = 4.5 V, R_{GEN} = 50 Ω		3.2	8	ns
t_r	Turn - On Rise Time			6	15	ns
$t_{D(off)}$	Turn - Off Delay Time			3.5	8	ns
t_f	Turn - Off Fall Time			3.5	8	ns
Q_g	Total Gate Charge	V_{DS} = 5 V, I_D = 0.2 A, V_{GS} = 4.5 V		0.49	0.7	nC
Q_{gs}	Gate-Source Charge			0.22		nC
Q_{gd}	Gate-Drain Charge			0.07		nC
DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS						
I_S	Maximum Continuous Drain-Source Diode Forward Current				0.29	A
V_{SD}	Drain-Source Diode Forward Voltage	V_{GS} = 0 V, I_S = 0.29 A (Note)		0.8	1.2	V

Note:
Pulse Test: Pulse Width ≤ 300µs, Duty Cycle ≤ 2.0%.

FDV301N Rev.F1

1.4.1.2. MOSFET-P

FAIRCHILD SEMICONDUCTOR®

May 2003

FDN360P

Single P-Channel, PowerTrench MOSFET

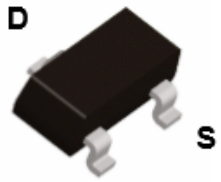
General Description

This P-Channel Logic Level MOSFET is produced using Fairchild Semiconductor advanced Power Trench process that has been especially tailored to minimize the on-state resistance and yet maintain low gate charge for superior switching performance.

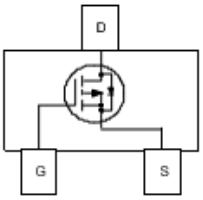
These devices are well suited for low voltage and battery powered applications where low in-line power loss and fast switching are required.

Features

- –2 A, –30 V. $R_{DS(ON)}$ = 80 mΩ @ V_{GS} = –10 V
  $R_{DS(ON)}$ = 125 mΩ @ V_{GS} = –4.5 V
- Low gate charge (6.2 nC typical)
- High performance trench technology for extremely low $R_{DS(ON)}$.
- High power version of industry Standard SOT-23 package. Identical pin-out to SOT-23 with 30% higher power handling capability.



SuperSOT™-3



Absolute Maximum Ratings

T_A=25°C unless otherwise noted

Symbol	Parameter		Ratings	Units
V_{DSS}	Drain-Source Voltage		–30	V
V_{GSS}	Gate-Source Voltage		±20	V
I_D	Drain Current – Continuous	(Note 1a)	–2	A
	– Pulsed		–10	
P_D	Power Dissipation for Single Operation	(Note 1a)	0.5	W
		(Note 1b)	0.46	
T_J, T_{STG}	Operating and Storage Junction Temperature Range		–55 to +150	°C

Thermal Characteristics

$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	(Note 1a)	250	°C/W
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	(Note 1)	75	°C/W

Package Marking and Ordering Information

Device Marking	Device	Reel Size	Tape width	Quantity
360	FDN360P	7"	8mm	3000 units

FDN360P

Electrical Characteristics

T_A = 25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Off Characteristics						
BV_{DSS}	Drain–Source Breakdown Voltage	V_{GS} = 0 V, I_D = –250 µA	–30			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	I_D = –250 µA, Referenced to 25°C		–22		mV/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = –24V, V_{GS} = 0 V			–1	µA
		V_{DS} = –24V, V_{GS} = 0 V, T_J=55°C			–10	
I_{GSSF}	Gate–Body Leakage, Forward	V_{GS} = 20 V, V_{DS} = 0 V			100	nA
I_{GSSR}	Gate–Body Leakage, Reverse	V_{GS} = –20 V, V_{DS} = 0 V			–100	nA
On Characteristics (Note 2)						
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = –250 µA	–1	–1.9	–3	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	I_D = –250 µA, Referenced to 25°C		4		mV/°C
$R_{DS(on)}$	Static Drain–Source On–Resistance	V_{GS} = –10 V, I_D = –2 A		63	80	mΩ
		V_{GS} = –10 V, I_D = –2 A, T_J=125°C		90	136	
		V_{GS}= –4.5 V, I_D = –1.5A		100	125	
$I_{D(on)}$	On–State Drain Current	V_{GS} = –10 V, V_{DS} = –5 V	–10			A
g_{FS}	Forward Transconductance	V_{DS} = –5 V, I_D = –2 A		5		S
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = –15 V, V_{GS} = 0 V, f = 1.0 MHz		298		pF
C_{oss}	Output Capacitance			83		pF
C_{rss}	Reverse Transfer Capacitance			39		pF
Switching Characteristics (Note 2)						
$t_{d(on)}$	Turn–On Delay Time	V_{DD} = –15 V, I_D = –1 A, V_{GS} = –10 V, R_{GEN} = 6 Ω		6	12	ns
t_r	Turn–On Rise Time			13	23	ns
$t_{d(off)}$	Turn–Off Delay Time			11	20	ns
t_f	Turn–Off Fall Time			6	12	ns
Q_g	Total Gate Charge	V_{DS} = –15V, I_D = –3.6 A, V_{GS} = –10 V		6.2	9	nC
Q_{gs}	Gate–Source Charge			1		nC
Q_{gd}	Gate–Drain Charge			1.2		nC
Drain–Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain–Source Diode Forward Current				–0.42	A
V_{SD}	Drain–Source Diode Forward Voltage	V_{GS} = 0 V, I_S = –0.42 A (Note 2)		–0.8	–1.2	V

Notes:

1. $R_{\theta JA}$ is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins. $R_{\theta JC}$ is guaranteed by design while $R_{\theta CA}$ is determined by the user's board design.

a) 250°C/W when mounted on a 0.02 in² pad of 2 oz. copper.

b) 270°C/W when mounted on a minimum pad.

Scale 1 : 1 on letter size paper

2. Pulse Test: Pulse Width ≤ 300 µs, Duty Cycle ≤ 2.0%

FDN360P Rev F1 (W)

2. TEXTIL ELECTROTÉRMICO

2.1. MATERIAL Y DESCRIPCIÓN

Patents & Awards

- Conductive yarn capable of withstanding dyeing, finishing and washing
  Issued patents:
  TW M371733
  CN 201485574U
  Pending application:
  US 12/ 787, 378

- Flexible heating element
  Pending applications:
  TW 099146482
  CN 201120008487.x

- 2014 TAITRONICS (Taiwan), Technology Innovation Awards – The Quality Award

Application

Wearable Heating

Automotive industry

Healthcare

Architecture

Agriculture

LiTex

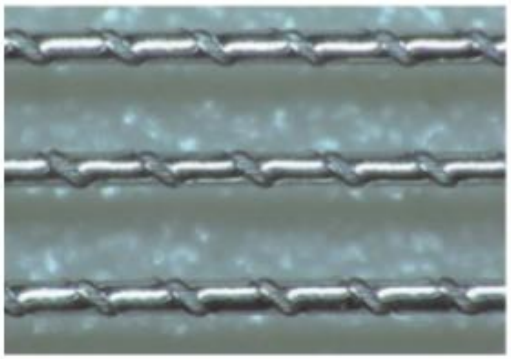
Characteristics Conductive Metal Yarn (CMY) Technology

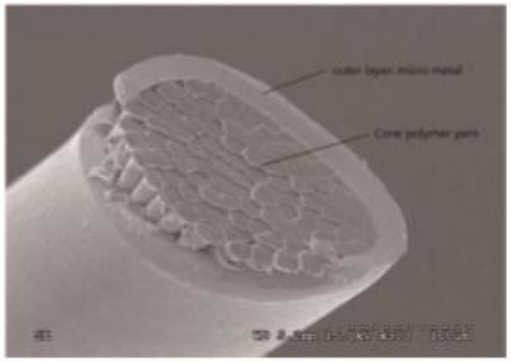
Features:

- Our specialized production technology:
  - Can simultaneously manufacture up to eight strands of CMY.
- Despite containing metal components, it possesses the characteristics of a fabric that is both flexible and resilient to physical wear.
- Can be as fine as 0.27 mm in diameter.
- OEM/ODM requests welcome.
- Can use almost any metal alloy.

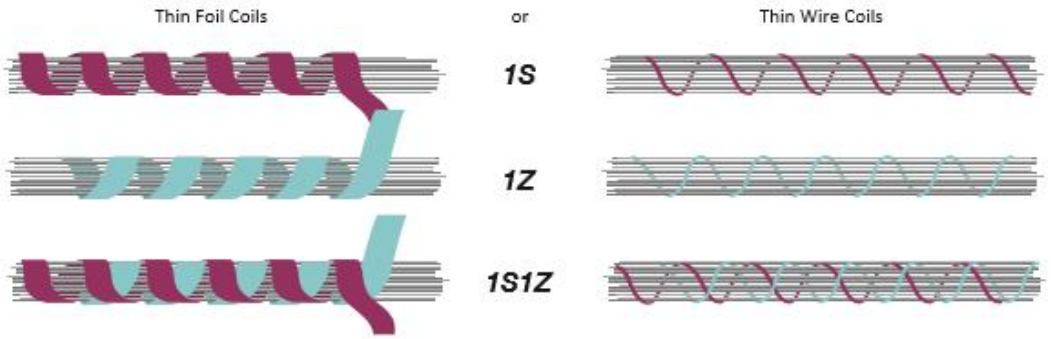
CMY Wire ▸

★ **Basic structure**





Above picture is structure 1S which is only covered with 1 metal coil.



Introduction:

Here at LiTex we have innovated the Conductive Metal Yarn (CMY). This is a new generation electric conductive yarn with flexible qualities that allows for various applications. Such technology is achieved by essentially coiling micro thin metal foil covering over a traditional polymer yarn core (see picture above) in a helical fashion. We are at the forefront of the industry for having the ability to simultaneously manufacture up to eight strands of coiled metal covering yarn with both helical metal plating covering at the same time. This construction allows us to have a textile characteristic micro-conductive yarn that is flexible while being tough in resisting physical wear. The coiled metal covering yarn can be very fine (0.27 mm diameter in present commercial grade). Further enhancements in conductivity, strength, and thermal resistance can be made according to your needs.

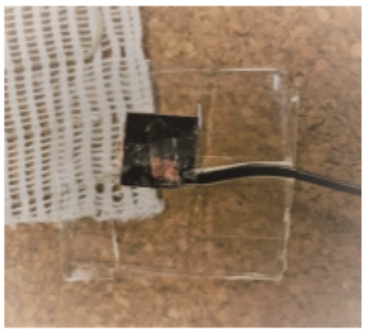
Different Copper foil CMY Available for Weaving							
Item	Metal Strand Coverings	Diameter (mm)		Resistance (Ω/M)	Coating Material		Toughness
		No Coating	Coating		PU	FEP (Teflon)	Weaker
010/N(K)30'*3/1S	1 Covering	0.27±0.02	0.47±0.05	~4.4		✓	
010/N(K)30'*3/1S1Z	2 Coverings	0.33±0.02	0.62±0.05	~2.5	✓	✓	
010/N(K)30'*3/2S2Z	4 Coverings	0.53±0.02	0.75±0.05	~1.4	✓	✓	
010/N(K)30'*3/3S3Z	6 Coverings	0.55±0.02	0.84±0.05	~1	✓	✓	
010/N(K)30'*3/4S4Z	8 Coverings	0.65±0.02		~0.8			Stronger

★ Above metal coverings are made from tinned copper.
Copper nickel (CuNi) varieties coming soon.

Comparison with Other Heating Elements

Heating Element	Material Characteristics	Manufacturing Process
Carbon Fiber	Brittle, easy breakage.	Most are integrated through manual labor.
Flexible Printed Circuit Board (Heating Film)	Thin board easy to snap.	Special equipments required for production and operation cost is high.
Stainless Steel Fiber	Filament bundle easily frayed	Most are integrated through manual labor.
Conductive Metal Yarn	Coiled design offers both flexibility and strength	Made ready to use by our looms. Can be easily mass manufactured.

Sturdy connector manufacturing service available.



◂Connector

2.2. CARACTERÍSTICAS TÉCNICAS

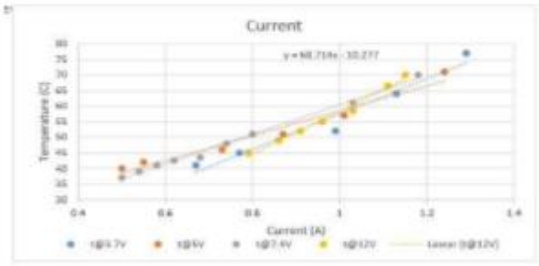
LiTex standard wearable spec.

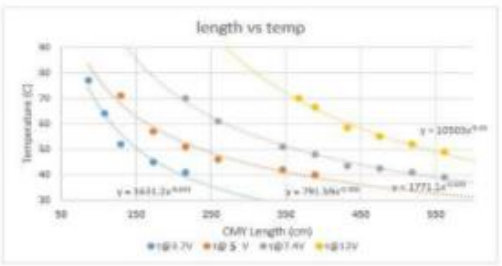
LiTex Standard Wearable Heating Textile

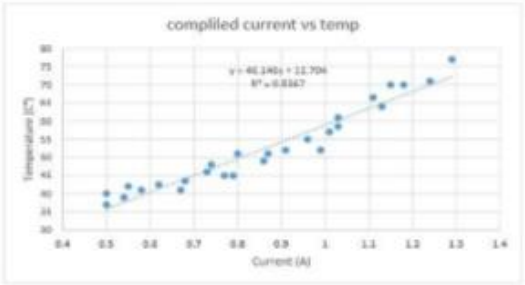
V. CAN BE MACHINE SEWN: Fabric include 10mm edge at both sides for sewing.
V. SOFT & FLAME RETARDANT: Polyester textile base material
V. TOUGH & WATERPROOF: Conductive Metal Yarn – PU coated Copper Alloy (1S1Z: 2 wire covering)
V. Conductive Metal Yarn (CMY) resistance per meter: 2.4 Ohm /M
V. Temperature resistance max: 70°C / 158°F
V. Put up: 50M / Roll

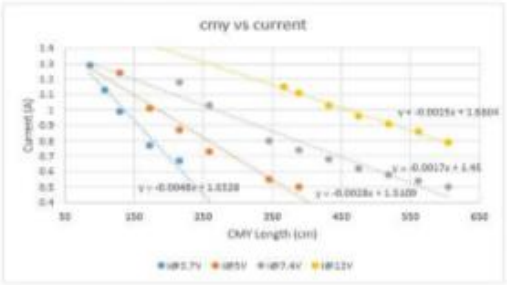
** CMY structure

1s1z CMY Performance Curves



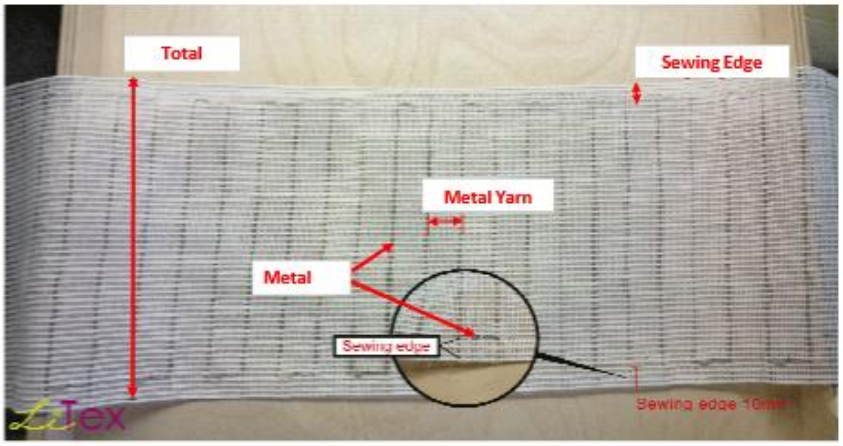






1s1z Heating Textile Standard Items:

Item #	1456(12)-12	2288(20)-8	2288(20)-12	30120(28)-10	30120(28)-15
Fabric width	14cm	22cm		30cm	
Heating area width	12cm	20cm		28cm	
Pitch of CMY on fabric	12±0.1mm	8±0.1mm	12±0.1mm	8±0.1mm	15±0.1mm



耳 1

Fabric Performance Under Different Conditions:

Item #	Heating Area Width (cm)	Textile Length (cm)	CMY Length (cm)	CMY Temp. (℃)	Input Volts (V)	Current (A)	Watts (W)
1456(12)-12	12	34	374	40	5	0.5	2.5
		22	242	50	5	0.8	4
		15	165	60	5	0.9	4.5
		11	121	70	5	1.1	5.5
		48	528	40	7.4	0.5	3.7
		33	363	50	7.4	0.8	5.92
		24	264	60	7.4	0.9	6.66
		19	209	70	7.4	1.1	8.14
		64	704	40	12	0.5	6
		49	539	50	12	0.8	9.6
		40	440	60	12	0.9	10.8
		33	363	70	12	1.1	13.2

Item #	Heating Area Width (cm)	Textile Length (cm)	CMY Length (cm)	CMY Temp. (℃)	Input Volts (V)	Current (A)	Watts (W)
2288(20)-8	20	14	364	40	5	0.5	2.5
		9	234	50	5	0.8	4
		6	156	60	5	0.9	4.5
		5	130	70	5	1.1	5.5
		20	520	40	7.4	0.5	3.7
		14	364	50	7.4	0.8	5.92
		10	260	60	7.4	0.9	6.66
		8	208	70	7.4	1.1	8.14
		27	702	40	12	0.5	6
		21	546	50	12	0.8	9.6
		17	442	60	12	0.9	10.8
		14	364	70	12	1.1	13.2
2288(20)-12		21	371	40	5	0.5	2.5
		13	230	50	5	0.8	4
		9	159	60	5	0.9	4.5
		7	124	70	5	1.1	5.5
		30	530	40	7.4	0.5	3.7
		21	371	50	7.4	0.8	5.92
		15	265	60	7.4	0.9	6.66
		12	212	70	7.4	1.1	8.14
		40	707	40	12	0.5	6
		31	548	50	12	0.8	9.6
		25	442	60	12	0.9	10.8
		21	371	70	12	1.1	13.2

LiTex standard wearable spec.

Item #	Heating Area Width (cm)	Textile Length (cm)	CMY Length (cm)	CMY Temp. (°C)	Input Volts (V)	Current (A)	Watts (W)
30120(28)-10	28	12	348	40	5	0.5	2.5
		8	232	50	5	0.8	4
		6	174	60	5	0.9	4.5
		4	116	70	5	1.1	5.5
		18	522	40	7.4	0.5	3.7
		12	348	50	7.4	0.8	5.92
		8	232	60	7.4	0.9	6.66
		6	174	70	7.4	1.1	8.14
		24	696	40	12	0.5	6
		18	522	50	12	0.8	9.6
		14	406	60	12	0.9	10.8
		12	348	70	12	1.1	13.2
30120(28)-15		18	354	40	5	0.5	2.5
		12	236	50	5	0.8	4
		9	177	60	5	0.9	4.5
		6	118	70	5	1.1	5.5
		27	531	40	7.4	0.5	3.7
		18	354	50	7.4	0.8	5.92
		12	236	60	7.4	0.9	6.66
		9	177	70	7.4	1.1	8.14
		36	708	40	12	0.5	6
		27	531	50	12	0.8	9.6
		21	413	60	12	0.9	10.8
		18	354	70	12	1.1	13.2

REMARK:
1. The temperature is set up in a condition of 20-25℃ room temperature.
2. The temperature data above is measured the temperature of the conductive metal yarn, not the surface of the fabric. The temperature of the fabric surface may be varied from the different metal yarn density /weaving pitch.
3. The data above is a rough calculation. For safety purpose, please double check the electric spec. & temperature before setting up the module.
4. Far- infrared function available on request.

頁 3

3. CÁMARA TERMOGRÁFICA

3.1. CÁMARA

We measure it. testo

Cámara termográfica

testo 882 - la cámara termográfica con elevada resolución de imagen

- Detector de 320 x 240 píxeles
- Tecnología SuperResolución (aumento a 640 x 480 píxeles)
- Sensibilidad térmica < 50 mK
- Cámara digital integrada con iluminación por LEDs
- Modo visualización del riesgo de condensación
- Medición de alta temperatura hasta 550 °C

La cámara termográfica testo 882 es el modelo superor de las fabricadas en el ergonómico diseño tipo "pistola". Este modelo destaca por su detector con matriz de 320 x 240 píxeles que permite ofrecer en la imágen térmica hasta 76.800 puntos de medición de temperatura, lo que sumado a la sensibilidad térmica mejorada < 50 mK permite descubrir cualquier detalle del objeto medido y medir hasta la diferencia en temperatura más inapreciable. Estas prestaciones facilitan la detección de anomalías o zonas críticas a mayores distancias y permite un trabajo con total fiabilidad.

www.testo.es

testo 882

We measure it.

Datos de pedido

testo 882

La cámara termográfica con 320 x 240 píxeles y < 60 mK, objetivo angular de 32°, opción de medición de temperatura elevada y registro de voz para la termografía más profesional

Modelo 0560 0882

Accesorios

	Código[1] (Equipamiento de serie)	Modelo (Retro instalación)	
SuperResolution. Cuatro veces más valores de medición para un análisis aún más detallado de las termografías.	S1	0554 7806	
Filtro protector del objetivo. Filtro protector de las lentes fabricado en germanio, evita arañazos y suciedad	C1	0554 8805	
Batería adicional. Batería de Li-Ion adicional, para aumentar el tiempo de funcionamiento	D1	0554 8802	
Cargador externo. Cargador rápido de sobremesa con capacidad para dos baterías simultáneamente	E1	0554 8801	
Medición de alta temperatura hasta +550 °C	G1	*)	
Riesgo de condensación*	B1	*)*)	
Cinta adhesiva de emisividad. Cinta adhesiva, p. ej., para superficies brillantes (rollo de 10 m de long., 25 mm de grosor), E = 0,95, resistente a la temperatura hasta +250 °C		0554 0051	
Certificado de calibración ISO; Puntos de calibración: 0 °C, 25 °C, 50 °C		0520 0489	
Certificado de calibración ISO; Puntos de calibración: 0 °C, 100 °C, 200 °C		0520 0490	
Certificado de calibración ISO; Puntos de calibración seleccionables libremente en el rango -18 °C a 250 °C		0520 0495	

* Sondas inalámbricas solo en la UE, Noruega, Suiza, EE.UU., Canadá, Colombia, Turquía, Brasil, Chile, México, Nueva Zelanda, Indonesia

[1] Si se solicitan junto a la cámara, los accesorios se envían directamente en la maleta. Por ejemplo: testo 882 con filtro de protección y batería de repuesto – código de pedido 0563 0882 C1 D1

*) Contacto con nuestro servicio técnico

*) Instalación en SAT

Datos técnicos

Salida imagen infrarrojos	
Tipo detector	FPA 320 x 240 píxeles, a-Si
Sensibilidad térmica (NETD)	‹50 mK a +30 °C
Campo de visión/distancia mín. de enfoque	32° x 23° / 0.2 m
Resolución geométrica (IFOV)	1.7 mrad
SuperResolution (píxel / IFOV) - opcional	640 x 480 píxeles / 1.1 mrad
Tasa de refresco	33*
Enfoque	enfoque manual y motorizado
Rango espectral	8 a 14 µm
Salida imagen real	
Tamaño imagen / distancia mín. enfoque	640 x 480 píxels
Presentación de la imagen	
Visualización de la imagen	3.5" LCD con 320 x 240 píxeles
Opciones de visualización	Solo imagen IR / solo imagen real / imagen IR y real
Salida vídeo	USB 2.0
Paletas de colores	10 (hierros, arco iris, arco iris AT, frío-caliente, rojo-azul, grises, grises invertido, sepia, Testo, hierros Al)
Medición	
Rango de temperatura	-20 °C a +100°C / 0 °C a +350 °C (seleccionable)
Medición de alta temperatura - opcional	+350 ... +550 °C
Exactitud	±2 °C, ±2% del v.m. / (±3% del v.m. a +350 ... +550 °C)
Emisividad / temperatura reflejada	0,01 ... 1 / manual
Funciones de la medición	
Visualización del riesgo de condensación (datos manuales)	✓
Medición de humedad con sonda inalámbrica (transmisión de datos en tiempo real)**	(✓)
Modo solar	✓
Funciones de análisis	hasta 2 puntos de medición, Autodetección del punto frío/caliente, Isotermas, Medición por zona (mín./máx. por área)

Equipamiento de la cámara	
Cámara digital	✓
Iluminación por LEDs	✓
Enfoque motorizado	✓
Objetivo angular	32° x 23°
Láser (clasificación 635 nm, Clase 2)***	✓
Registro de voz	auriculares con cable
Video streaming (vía USB)	✓
Memorización de la imagen	
Formato de archivo	.bmt; opciones de exportación en .bmp, .jpg, .csv
Soporte almacenamiento	Tarjeta SD 2 Gb (aprox. 1.000 imágenes)
Alimentación	
Tipo de batería	Batería de lón litio de recarga rápida, reemplazable in situ
Duración	4 horas
Opciones de recarga	En el instrumento/en el cargador externo (opcional)
Conexión a red	sí
Condiciones ambiente	
Temperatura funcionamiento	-15 ... +40 °C
Temperatura almacenamiento	-30 ... +60 °C
Humedad del aire	20 % a 80 % sin condensación
Clase de protección (IEC 60529)	IP54
Vibración (IEC 60068-2-6)	2G
Otros datos técnicos	
Peso	aprox. 900 g
Medidas (L x An x Al)	152 x 108 x 262
Adaptador para trípode	M6
Carcasa	ABS
Software para PC	
Requisitos del sistema	Windows XP (Service Pack 3), Windows Vista, Windows 7 (Service Pack 1), interfaz USB 2.0
Certificaciones y garantía	
Directiva UE	2004 / 108 / EC
Garantía	2 años

* en zona UE, 9 Hz fuera zona UE
** Sondas inalámbricas solo en la UE, Noruega, Suiza, EE.UU., Canadá, Colombia, Turquía, Brasil, Chile, México, Nueva Zelanda, Indonesia
*** excepto USA, China y Japón

✓ de serie
(✓) opcional

testo 882

We measure it. testo

Descripción

Detector	320 x 240 píxeles
Sensibilidad térmica (NETD)	< 50 mK
Rango de temperatura	-20 a +350 °C
Tasa de refresco	33 Hz*
Objetivo 32° x 23°	✓
SuperResolution	(✓)
medición de alta temperatura hasta 550 °C	(✓)
Cámara digital integrada	✓
Iluminación por LEDs	✓
Láser**	✓
Visualización del riesgo de condensación (manual)	✓
Visualización del riesgo de condensación (con sonda inalámbrica***) (transmisión de los datos en tiempo real)	(✓)
Auriculares para registro de voz	✓
Enfoque motorizado	✓
Visualización de isotermas en pantalla	✓
Cálculo de mín/máx por área	✓
Autodetección del punto frío/caliente	✓
Modo solar	✓
Filtro de protección	(✓)
Batería de repuesto	(✓)
Cargador de sobremesa	(✓)

✓ de serie

(✓) opcional

* en zona UE, 9 Hz fuera zona UE
** excepto USA, China y Japón
*** Sondas inalámbricas solo en la UE, Noruega, Suiza, EE.UU., Canadá, Colombia, Turquía, Brasil, Chile, México, Nueva Zelanda, Indonesia

Instrumentos Testo, S.A.
P.I. La Baileta-Can Xinxa, C/ B, nº 2
08348 Cabrils (Barcelona)
Tel: 937 539 520
Fax: 937 539 526
E-Mail: info@testo.es

www.testo.es

Especificaciones cámara termográfica testo 882

gmt GESTION MAQUINARIA TECNICA EQUIPOS TECNICOS
GIMATEG
Calle Antonio Cusido 136 Bajo
08208 SABADELL (Barcelona)
937071855 - 627152432 Fax.-937247140

Descripción del producto

testo 882

Cámara termográfica con detector de 320 x 240 píxeles para visualizar hasta el último detalle.

TESTO 882.-
Opcion ampliada de Foto Termica con software IRsoft aproximadamente = hasta 640x480
.
VENTA-ALQUILER

Opcion = Foto TERMICA Super Resolucion T882 de 320x240 aprox 640x480

Modelo: testo 882 — 0560 0882

Sectores de venta

Ingenieros independientes
Contratistas
Climatización en instalaciones
Mantenimiento General de Plantas de Producción
Mantenimiento de Plantas con Procesos de Alta Tensión

Aplicaciones Principales

Consultorías energéticas (interior/exterior) en edificios
Detección de fallos constructivos / control calidad edificación
Mantenimiento preventivo de equipamiento eléctrico
Mantenimiento preventivo de equipamiento mecánico

Prestaciones

Detector de 320 x 240 píxeles
Amplio campo de visión gracias al objetivo angular de 32°
Alta calidad de imagen gracias a la NETD < 60 mK que detecta incluso las diferencias en temperatura más imperceptibles
Auriculares y micro para el registro por voz de datos y hechos importantes
Cámara digital integrada con LEDs
Medición especial para detectar zonas con riesgo de condensación
Medición de elevada temperatura hasta +550°C (opcional)
Visualización de isotermas en pantalla, cálculo del Mín/Máx por área, reconocimiento automático del punto frío/caliente
Software IRSoft para un cómodo análisis y elaboración de informes

Imagen del producto

Datos técnicos

Detector	FPA 320 x 240 Píxeles, a.Si.
NETD	< 60 mK
Campo de visión / IFOV	32° x 23° / 1,7mrad
Rango de temperatura	-20 .... +350°C (opcional: +550°C)
Exactitud	+/- 2°C o 2% del v.m. (-20 ... +350), +/-3% del v.m. (+350 .... +550°C)
Tasa de refresco	33 Hz (zona UE), 9 Hz (zona no UE)
Cámara digital	640 x 480 Píxeles
Iluminación por LEDs	Sí
Registro de voz	Mediante auriculares
Enfoque motorizado	Sí
Indicador láser	Sí (excepto en USA, China y Japón)
Pantalla	3,5" apaisada
Temperatura funcionam.	-15 ... +40°C
Clase de protección	IP 54
Peso	Aprox. 900 g
Requisitos del software para PC	Windows XP (Service Pack 2), Windows 7, Windows Vista, interface USB 2.0

3.2. SOFTWARE DE CONTROL

IRSoft · Software para PC

Manual de instrucciones

1 Índice

1 Índice