

Návrh zadání na měření laboratorní úlohy

Měření teploty dotykovým způsobem

Michal Zajíc



Cíl úlohy:

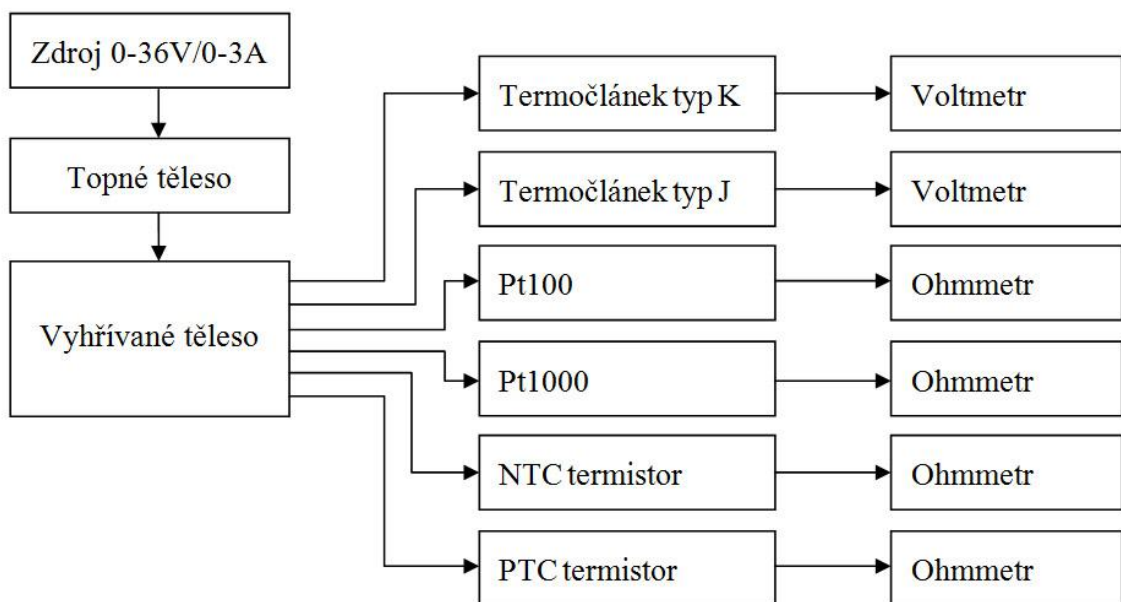
Měření a vyhodnocení základních statických charakteristik pro senzory teploty NTC, PTC termistor, Pt100, Pt1000, termočlánek typu J a K.

Vybrané senzory teploty:

- NTC termistor Epcos
- PTC termistor NXP
- Termočláanky Guenther - typ J a K
- Platinové odporové senzory - Pt100 a Pt1000

Obecný popis úlohy:

Hliníkové těleso je vyhříváno na teplotu od 30°C až po 80°C za pomoci dvou metal oxidových rezistorů, každý o výkonu 20W. Reálná teplota tělesa je měřena digitálním dotykovým teploměrem. Přímo na tělese jsou umístěny senzory, na nichž se měří výstupní signály za pomoci ohmmetru nebo voltmetru. Naměřené hodnoty se vyhodnotí a z nich se vytvoří základní statické charakteristiky senzorů. Blokové schéma úlohy je zobrazeno na obr. 1. Kompletní sestava úlohy včetně měřících zařízení je ukázána na obr. 2.



Obr. 1: Blokové schéma zapojení



Obr. 2: Kompletní měřící sestava úlohy

Použité měřící přístroje a zařízení:

Napájecí zdroj: ARRAY 3645A 0-36V/0-3A DC

Digitální stolní multimetr*: Agilent 34401A 6 1/2 Digit Multimeter

Digitální multimetr**: CEM DT-9602

Digitální dotykový teploměr: KIMO TM200

Pozn.:

**Pro měření výstupních signálů z termočlánků je potřeba využít digitálního stolního multimetru Agilent 34401A z důvodu nízkého výstupního napětí termočlánků, které je v řádu milivoltů.*

***Pro měření ostatních senzorů jsou svým rozsahem dostačující ruční multimetry CEM DT-9602.*

Postup měření:

Nejprve se seznámte s úlohou a nastudujte teorii k dané problematice z doporučené literatury [1]. Následně se seznámte s technickými parametry daných senzorů, které jsou uvedeny v technických dokumentacích v přílohách P1 až P6. Nastavte na zdroji napětí 20V a proud 1,8A. Manuálním zapínáním a vypínáním výstupu zdroje regulujte teplotu tělesa. Pro měření teploty tělesa využijte digitálního dotykového teploměru. Měření proveďte pro 7 různých teplot, nejprve pro pokojovou teplotu a dále v rozsahu od 30°C do 80°C po kroku 10°C. Pro každou teplotu proveďte 10x odečet výstupních signálů včetně teploty. Data zpracujte do tabulek a následně z naměřených hodnot určete minimum, maximum, průměrnou hodnotu a směrodatnou odchylku. Z průměrných hodnot vytvořte základní statickou charakteristiku pro každý měřený senzor. Měření a vyhodnocení zpracujte formou protokolu a to dle požadavků předmětu Senzory.

SEZNAM DOPORUČENÉ LITERATURY

- [1] HRUŠKA, František. *Senzory: fyzikální principy, úpravy signálů, praktické použití (e-book)*. 2. rozš. vyd. Ve Zlíně: Univerzita Tomáše Bati ve Zlíně, 2011, [202] s. ISBN 978-80-7454-096-7.

SEZNAM PŘÍLOH

- P1 Technické dokumentace NTC termistor Epcos
P2 Technická dokumentace PTC termistor NXP
P3 Referenční tabulky termočlánu typu J
P4 Referenční tabulky termočlánu typu K
P5 Technická dokumentace Pt100
P6 Technická dokumentace Pt1000



NTC thermistors for temperature measurement

Probe assemblies

Series/Type: B57703M
Date: February 2009

Applications

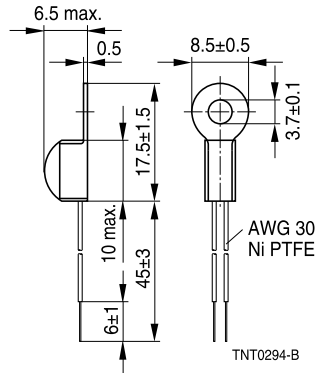
- Surface temperature measurement, e.g. on housings and heat sinks

Features

- High accuracy
- Easy mounting
- Good thermal coupling through metal tag
- Thermistor encapsulated in metal-tag case
- PTFE-insulated leads of silver-plated nickel wire, AWG 30
- UL approval (E69802)

Options

- Alternative resistance ratings, rated temperatures, resistance tolerances, lead lengths and AWG 26 or AWG 28 stranded wires available on request.

Dimensional drawing

Delivery mode

Bulk

Dimensions in mm

Approx. weight 0.8 g

General technical data

Climatic category	(IEC 60068-1)		55/125/56	
Max. power	(at 25 °C)	P_{25}	150	mW
Resistance tolerance		$\Delta R_R/R_R$	±2	%
Rated temperature		T_R	25	°C
Dissipation factor	(in air)	$\delta_{th}^{(1)}$	approx. 3	mW/K
Thermal cooling time constant	(in air)	$\tau_c^{(1)}$	approx. 50	s
Heat capacity		$C_{th}^{(1)}$	approx. 150	mJ/K
Test voltage	(t = 1 s)	V_{test}	1000	V AC

Electrical specification and ordering codes

R_{25} Ω	No. of R/T characteristic	$B_{25/100}$ K	Ordering code
5 k	8016	3988 ±1%	B57703M0502G040
10 k	8016	3988 ±1%	B57703M0103G040
30 k	8018	3964 ±1%	B57703M0303G040

1) Depends on mounting situation.

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: 125 °C t: 1000 h	< 1%	No visible damage
Storage in damp heat, steady state	IEC 60068-2-78	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: –55 °C Upper test temperature: 125 °C Number of cycles: 10	< 0.5%	No visible damage
Endurance		P_{max} : 150 mW t: 1000 h	< 1%	No visible damage
Long-term stability (empirical value)		Temperature: 70 °C t: 10000 h	< 2%	No visible damage

R/T characteristics

R/T No.	8016		8018	
T (°C)	B _{25/100} = 3988 K		B _{25/100} = 3964 K	
	R _T /R ₂₅	α (%/K)	R _T /R ₂₅	α (%/K)
-55.0	96.3	7.4	—	—
-50.0	67.01	7.2	—	—
-45.0	47.17	6.9	—	—
-40.0	33.65	6.7	30.24	6.3
-35.0	24.26	6.4	22.1	6.1
-30.0	17.7	6.2	16.32	5.9
-25.0	13.04	6.0	12.17	5.8
-20.0	9.707	5.8	9.153	5.6
-15.0	7.293	5.6	6.945	5.4
-10.0	5.533	5.5	5.313	5.2
-5.0	4.232	5.3	4.097	5.1
0.0	3.265	5.1	3.183	4.9
5.0	2.539	5.0	2.491	4.8
10.0	1.99	4.8	1.963	4.7
15.0	1.571	4.7	1.557	4.6
20.0	1.249	4.5	1.244	4.4
25.0	1.0000	4.4	1.0000	4.3
30.0	0.8057	4.3	0.8083	4.2
35.0	0.6531	4.1	0.6572	4.1
40.0	0.5327	4.0	0.5373	4.0
45.0	0.4369	3.9	0.4418	3.9
50.0	0.3603	3.8	0.365	3.7
55.0	0.2986	3.7	0.303	3.7
60.0	0.2488	3.6	0.2527	3.6
65.0	0.2083	3.5	0.2118	3.5
70.0	0.1752	3.4	0.1783	3.4
75.0	0.1481	3.3	0.1508	3.3
80.0	0.1258	3.2	0.128	3.2
85.0	0.1072	3.2	0.1091	3.2
90.0	0.09177	3.1	0.0933	3.1
95.0	0.07885	3.0	0.08016	3.0
100.0	0.068	2.9	0.0691	2.9
105.0	0.05886	2.9	0.05974	2.9
110.0	0.05112	2.8	0.05183	2.8
115.0	0.04454	2.7	0.04512	2.8
120.0	0.03893	2.6	0.0394	2.7
125.0	0.03417	2.6	0.0345	2.6
130.0	0.03009	2.5	0.03032	2.6
135.0	0.02654	2.5	0.02672	2.5
140.0	0.02348	2.4	0.02361	2.5
145.0	0.02083	2.4	0.02091	2.4
150.0	0.01853	2.3	0.01857	2.4
155.0	0.01653	2.3	0.016537	2.3



Cautions and warnings General

See "Important notes" at the end of this document.

Storage

- Store thermistors only in original packaging. Do not open the package prior to storage.
- Storage conditions in original packaging: storage temperature $-25\text{ °C} \dots +45\text{ °C}$, relative humidity $\leq 75\%$ annual mean, $< 95\%$ maximum 30 days per annum, dew precipitation is inadmissible.
- Do not store thermistors where they are exposed to heat or direct sunlight. Otherwise, the packing material may be deformed or components may stick together, causing problems during mounting.
- Avoid contamination of thermistor surface during storage, handling and processing.
- Avoid storage of thermistors in harmful environments like corrosive gases (SO_x , Cl etc).
- Use the components as soon as possible after opening the factory seals, i.e. the polyvinyl-sealed packages.
- Solder thermistors within the time specified after shipment from EPCOS.
For leaded components this is 24 months, for SMDs 12 months.

Handling

- NTC thermistors must not be dropped. Chip-offs or any other damage must not be caused during handling of NTCs.
- Do not touch components with bare hands. Gloves are recommended.
- Avoid contamination of thermistor surface during handling.

Bending / twisting leads

- A lead (wire) may be bent at a minimum distance of twice the wire's diameter plus 4 mm from the component head or housing. When bending ensure the wire is mechanically relieved at the component head or housing. The bending radius should be at least 0.75 mm.
- Twisting (torsion) by 180° of a lead bent by 90° is permissible at 6 mm from the bottom of the thermistor body.

Soldering

- Use resin-type flux or non-activated flux.
- Insufficient preheating may cause ceramic cracks.
- Rapid cooling by dipping in solvent is not recommended.
- Complete removal of flux is recommended.

Mounting

- Ensure that no thermo-mechanical stress occurs due to production processes (curing or overmolding processes) when thermistors are sealed, potted or overmolded or during their subsequent operation. The maximum temperature of the thermistor must not be exceeded. Ensure that the materials used (sealing/potting compound and plastic material) are chemically neutral.
- Electrodes/contacts must not be scratched or damaged before/during/after the mounting process.
- Contacts and housing used for assembly with the thermistor must be clean before mounting.
- Ensure that adjacent materials are designed for operation at temperatures comparable to the surface temperature of the thermistor. Be sure that surrounding parts and materials can withstand the temperature.
- Avoid contamination of the thermistor surface during processing.
- The connections of sensors (e.g. cable end, wire end, plug terminal) may only be exposed to an environment with normal atmospheric conditions.
- Tensile forces on cables or leads must be avoided during mounting and operation.
- Bending or twisting of cables or leads directly on the thermistor body is not permissible.
- Avoid using chemical substances as mounting aids. It must be ensured that no water or other liquids enter the NTC thermistors (e.g. through plug terminals). In particular, water based substances (e.g. soap suds) must not be used as mounting aids for sensors.

Operation

- Use thermistors only within the specified operating temperature range.
- Use thermistors only within the specified power range.
- Environmental conditions must not harm the thermistors. Only use the thermistors under normal atmospheric conditions or within the specified conditions.
- Contact of NTC thermistors with any liquids and solvents should be prevented. It must be ensured that no water enters the NTC thermistors (e.g. through plug terminals). For measurement purposes (checking the specified resistance vs. temperature), the component must not be immersed in water but in suitable liquids (e.g. Galden).
- Avoid dewing and condensation unless thermistor is specified for these conditions.
- Bending or twisting of cables and/or wires is not permissible during operation of the sensor in the application.
- Be sure to provide an appropriate fail-safe function to prevent secondary product damage caused by malfunction.

This listing does not claim to be complete, but merely reflects the experience of EPCOS AG.

Symbols and terms

Symbol	English	German
A	Area	Fläche
AWG	American Wire Gauge	Amerikanische Norm für Drahtquerschnitte
B	B value	B-Wert
B _{25/100}	B value determined by resistance measurement at 25 °C and 100 °C	B-Wert, ermittelt durch Widerstandsmessungen bei 25 °C und 100 °C
C _{th}	Heat capacitance	Wärmekapazität
I	Current	Strom
N	Number (integer)	Anzahl (ganzzahliger Wert)
P ₂₅	Maximum power at 25 °C	Maximale Leistung bei 25 °C
P _{diss}	Power dissipation	Verlustleistung
P _{ei}	Electrical power	Elektrische Leistung
P _{max}	Maximum power within stated temperature range	Maximale Leistung im angegebenen Temperaturbereich
$\Delta R_B/R_B$	Resistance tolerance caused by spread of B value	Widerstandstoleranz, die durch die Streuung des B-Wertes verursacht wird
R _{ins}	Insulation resistance	Isolationswiderstand
R _p	Parallel resistance	Parallelwiderstand
R _R	Rated resistance	Nennwiderstand
$\Delta R_R/R_R$	Resistance tolerance	Widerstandstoleranz
R _S	Series resistance	Serienwiderstand
R _T	Resistance at temperature T (e.g. R ₂₅ = resistance at 25 °C)	Widerstand bei Temperatur T (z.B. R ₂₅ = Widerstand bei 25 °C)
T	Temperature	Temperatur
ΔT	Temperature tolerance	Temperaturtoleranz
t	Time	Zeit
T _A	Ambient temperature	Umgebungstemperatur
T _{max}	Upper category temperature	Obere Grenztemperatur (Kategorietemperatur)
T _{min}	Lower category temperature	Untere Grenztemperatur (Kategorietemperatur)
T _{op}	Operating temperature	Betriebstemperatur
T _R	Rated temperature	Nenntemperatur
T _{surf}	Surface temperature	Oberflächentemperatur
V	Voltage	Spannung
V _{ins}	Insulation test voltage	Isolationsprüfspannung
V _{op}	Operating voltage	Betriebsspannung
V _{test}	Test voltage	Prüfspannung

Symbol	English	German
α	Temperature coefficient	Temperaturkoeffizient
Δ	Tolerance, change	Toleranz, Änderung
δ_{th}	Dissipation factor	Wärmeleitwert
τ_c	Thermal cooling time constant	Thermische Abkühlzeitkonstante
τ_a	Thermal time constant	Thermische Zeitkonstante

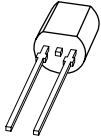
Abbreviations / Notes

Symbol	English	German
<u>SMD</u>	Surface-mounted devices	Oberflächenmontierbares Bauelement
*	To be replaced by a number in ordering codes, type designations etc.	Platzhalter für Zahl im Bestellnummerncode oder für die Typenbezeichnung.
+	To be replaced by a letter. All dimensions are given in mm. The commas used in numerical values denote decimal points.	Platzhalter für einen Buchstaben. Alle Maße sind in mm angegeben. Verwendete Kommas in Zahlenwerten bezeichnen Dezimalpunkte.

Important notes

The following applies to all products named in this publication:

1. Some parts of this publication contain **statements about the suitability of our products for certain areas of application**. These statements are based on our knowledge of typical requirements that are often placed on our products in the areas of application concerned. We nevertheless expressly point out **that such statements cannot be regarded as binding statements about the suitability of our products for a particular customer application**. As a rule, EPCOS is either unfamiliar with individual customer applications or less familiar with them than the customers themselves. For these reasons, it is always ultimately incumbent on the customer to check and decide whether an EPCOS product with the properties described in the product specification is suitable for use in a particular customer application.
2. We also point out that **in individual cases, a malfunction of electronic components or failure before the end of their usual service life cannot be completely ruled out in the current state of the art, even if they are operated as specified**. In customer applications requiring a very high level of operational safety and especially in customer applications in which the malfunction or failure of an electronic component could endanger human life or health (e.g. in accident prevention or lifesaving systems), it must therefore be ensured by means of suitable design of the customer application or other action taken by the customer (e.g. installation of protective circuitry or redundancy) that no injury or damage is sustained by third parties in the event of malfunction or failure of an electronic component.
3. **The warnings, cautions and product-specific notes must be observed.**
4. In order to satisfy certain technical requirements, **some of the products described in this publication may contain substances subject to restrictions in certain jurisdictions (e.g. because they are classed as hazardous)**. Useful information on this will be found in our Material Data Sheets on the Internet (www.epcos.com/material). Should you have any more detailed questions, please contact our sales offices.
5. We constantly strive to improve our products. Consequently, **the products described in this publication may change from time to time**. The same is true of the corresponding product specifications. Please check therefore to what extent product descriptions and specifications contained in this publication are still applicable before or when you place an order. We also **reserve the right to discontinue production and delivery of products**. Consequently, we cannot guarantee that all products named in this publication will always be available. The aforementioned does not apply in the case of individual agreements deviating from the foregoing for customer-specific products.
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KTY81 series

Silicon temperature sensors

Rev. 05 — 25 April 2008

Product data sheet

1. Product profile

1.1 General description

The temperature sensors in the KTY81 series have a positive temperature coefficient of resistance and are suitable for use in measurement and control systems. The sensors are encapsulated in the SOD70 2 in-line leads plastic package.

Other special selections are available on request.

CAUTION



This device is sensitive to ElectroStatic Discharge (ESD). Therefore care should be taken during transport and handling.

1.2 Features

- High accuracy and reliability
- Positive temperature coefficient; fail-safe behavior
- Long-term stability
- Virtually linear characteristics

1.3 Quick reference data

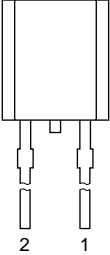
Table 1. Quick reference data

$T_{amb} = 25\text{ }^{\circ}\text{C}$; in liquid; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
R_{25}	sensor resistance	$I_{sen(cont)} = 1\text{ mA}$				
		KTY81/110	990	-	1010	Ω
		KTY81/120	980	-	1020	Ω
		KTY81/121	980	-	1000	Ω
		KTY81/122	1000	-	1020	Ω
		KTY81/150	950	-	1050	Ω
		KTY81/210	1980	-	2020	Ω
		KTY81/220	1960	-	2040	Ω
		KTY81/221	1960	-	2000	Ω
		KTY81/222	2000	-	2040	Ω
		KTY81/250	1900	-	2100	Ω

2. Pinning information

Table 2. Pinning

Pin	Description	Simplified outline
1	electrical contact	
2	electrical contact	

3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
KTY81/110	-	plastic near cylindrical single-ended package; 2 in-line leads	SOD70
KTY81/120			
KTY81/121			
KTY81/122			
KTY81/150			
KTY81/210			
KTY81/220			
KTY81/221			
KTY81/222			
KTY81/250			

4. Marking

Table 4. Marking codes

Type number	Marking code
KTY81/110	110
KTY81/120	120
KTY81/121	121
KTY81/122	122
KTY81/150	150
KTY81/210	210
KTY81/220	220
KTY81/221	221
KTY81/222	222
KTY81/250	250

5. Limiting values

Table 5. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
$I_{\text{sen(cont)}}$	continuous sensor current	in free air; $T_{\text{amb}} = 25\text{ °C}$	-	10	mA
		in free air; $T_{\text{amb}} = 150\text{ °C}$	-	2	mA
T_{amb}	ambient temperature		-55	+150	°C

6. Characteristics

Table 6. Characteristics

$T_{\text{amb}} = 25\text{ °C}$; in liquid; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
R_{25}	sensor resistance	$I_{\text{sen(cont)}} = 1\text{ mA}$				
		KTY81/110	990	-	1010	Ω
		KTY81/120	980	-	1020	Ω
		KTY81/121	980	-	1000	Ω
		KTY81/122	1000	-	1020	Ω
		KTY81/150	950	-	1050	Ω
		KTY81/210	1980	-	2020	Ω
		KTY81/220	1960	-	2040	Ω
		KTY81/221	1960	-	2000	Ω
		KTY81/222	2000	-	2040	Ω
TC	temperature coefficient		-	0.79	-	%/K
R_{100}/R_{25}	resistance ratio	$T_{\text{amb}} = 100\text{ °C}$ and 25 °C	1.676	1.696	1.716	
R_{-55}/R_{25}	resistance ratio	$T_{\text{amb}} = -55\text{ °C}$ and 25 °C	0.480	0.490	0.500	
ΔR_{25}	drift of sensor resistance at 25 °C	10000 h continuous operation; $T_{\text{amb}} = 150\text{ °C}$				
		KTY81/1 series	-	1.6	-	Ω
		KTY81/2 series	-	3.2	-	Ω
τ_{th}	thermal time constant	in still air	[1] -	30	-	s
		in still liquid	[1] -	5	-	s
		in flowing liquid	[1] -	3	-	s

- [1] The thermal time constant is the time taken for the sensor to reach 63.2 % of the total temperature difference. For example, if a sensor with a temperature of 25 °C is moved to an environment with an ambient temperature of 100 °C , the time for the sensor to reach a temperature of 72.4 °C is the thermal time constant.

Table 7. Ambient temperature, corresponding resistance, temperature coefficient and maximum expected temperature error for KTY81/110 and KTY81/120 $I_{sen(cont)} = 1\text{ mA}$.

Ambient temperature		Temperature coefficient (%/K)	KTY81/110				KTY81/120			
(°C)	(°F)		Resistance (Ω)			Temperature error (K)	Resistance (Ω)			Temperature error (K)
			Min	Typ	Max		Min	Typ	Max	
-55	-67	0.99	475	490	505	±3.02	470	490	510	±4.02
-50	-58	0.98	500	515	530	±2.92	495	515	535	±3.94
-40	-40	0.96	552	567	582	±2.74	547	567	588	±3.78
-30	-22	0.93	609	624	638	±2.55	603	624	645	±3.62
-20	-4	0.91	669	684	698	±2.35	662	684	705	±3.45
-10	14	0.88	733	747	761	±2.14	726	747	769	±3.27
0	32	0.85	802	815	828	±1.91	793	815	836	±3.08
10	50	0.83	874	886	898	±1.67	865	886	907	±2.88
20	68	0.80	950	961	972	±1.41	941	961	982	±2.66
25	77	0.79	990	1000	1010	±1.27	980	1000	1020	±2.54
30	86	0.78	1029	1040	1051	±1.39	1018	1040	1061	±2.68
40	104	0.75	1108	1122	1136	±1.64	1097	1122	1147	±2.97
50	122	0.73	1192	1209	1225	±1.91	1180	1209	1237	±3.28
60	140	0.71	1278	1299	1319	±2.19	1265	1299	1332	±3.61
70	158	0.69	1369	1392	1416	±2.49	1355	1392	1430	±3.94
80	176	0.67	1462	1490	1518	±2.8	1447	1490	1532	±4.3
90	194	0.65	1559	1591	1623	±3.12	1543	1591	1639	±4.66
100	212	0.63	1659	1696	1733	±3.46	1642	1696	1750	±5.05
110	230	0.61	1762	1805	1847	±3.83	1744	1805	1865	±5.48
120	248	0.58	1867	1915	1963	±4.33	1848	1915	1982	±6.07
125	257	0.55	1919	1970	2020	±4.66	1899	1970	2040	±6.47
130	266	0.52	1970	2023	2077	±5.07	1950	2023	2097	±6.98
140	284	0.45	2065	2124	2184	±6.28	2043	2124	2205	±8.51
150	302	0.35	2145	2211	2277	±8.55	2123	2211	2299	±11.43

Table 8. Ambient temperature, corresponding resistance, temperature coefficient and maximum expected temperature error for KTY81/121 and KTY81/122 $I_{sen(cont)} = 1 \text{ mA}$.

Ambient temperature		Temperature coefficient (%/K)	KTY81/121				KTY81/122			
(°C)	(°F)		Resistance (Ω)			Temperature error (K)	Resistance (Ω)			Temperature error (K)
			Min	Typ	Max		Min	Typ	Max	
-55	-67	0.99	471	485	500	±3.02	480	495	510	±3.02
-50	-58	0.98	495	510	524	±2.92	505	520	535	±2.92
-40	-40	0.96	547	562	576	±2.74	558	573	588	±2.74
-30	-22	0.93	603	617	632	±2.55	615	630	645	±2.55
-20	-4	0.91	662	677	691	±2.35	676	690	705	±2.35
-10	14	0.88	726	740	754	±2.14	741	755	769	±2.14
0	32	0.85	794	807	820	±1.91	810	823	836	±1.91
10	50	0.83	865	877	889	±1.67	883	895	907	±1.67
20	68	0.80	941	951	962	±1.41	960	971	982	±1.41
25	77	0.79	980	990	1000	±1.27	1000	1010	1020	±1.27
30	86	0.78	1018	1029	1041	±1.39	1039	1050	1062	±1.39
40	104	0.75	1097	1111	1125	±1.64	1120	1134	1148	±1.64
50	122	0.73	1180	1196	1213	±1.91	1204	1221	1238	±1.91
60	140	0.71	1266	1286	1305	±2.19	1291	1312	1332	±2.19
70	158	0.69	1355	1378	1402	±2.49	1382	1406	1430	±2.49
80	176	0.67	1447	1475	1502	±2.8	1477	1505	1533	±2.8
90	194	0.65	1543	1575	1607	±3.12	1574	1607	1639	±3.12
100	212	0.63	1642	1679	1716	±3.46	1676	1713	1750	±3.46
110	230	0.61	1745	1786	1828	±3.83	1780	1823	1865	±3.83
120	248	0.58	1849	1896	1943	±4.33	1886	1934	1982	±4.33
125	257	0.55	1900	1950	2000	±4.66	1938	1989	2041	±4.66
130	266	0.52	1950	2003	2056	±5.07	1989	2044	2098	±5.07
140	284	0.45	2044	2103	2162	±6.28	2085	2146	2206	±6.28
150	302	0.35	2124	2189	2254	±8.55	2167	2233	2299	±8.55

Table 9. Ambient temperature, corresponding resistance, temperature coefficient and maximum expected temperature error for KTY81/150 $I_{sen(cont)} = 1\text{ mA}$.

Ambient temperature		Temperature coefficient (%/K)	KTY81/150			
(°C)	(°F)		Resistance (Ω)			Temperature error (K)
			Min	Typ	Max	
-55	-67	0.99	456	490	524	±7.04
-50	-58	0.98	479	515	550	±6.99
-40	-40	0.96	530	567	605	±6.91
-30	-22	0.93	584	624	663	±6.84
-20	-4	0.91	642	684	725	±6.77
-10	14	0.88	703	747	791	±6.69
0	32	0.85	769	815	861	±6.61
10	50	0.83	838	886	934	±6.51
20	68	0.80	912	961	1010	±6.41
25	77	0.79	950	1000	1050	±6.35
30	86	0.78	987	1040	1093	±6.55
40	104	0.75	1064	1122	1181	±6.97
50	122	0.73	1143	1209	1274	±7.4
60	140	0.71	1226	1299	1371	±7.85
70	158	0.69	1313	1392	1472	±8.31
80	176	0.67	1402	1490	1577	±8.79
90	194	0.65	1495	1591	1687	±9.29
100	212	0.63	1591	1696	1801	±9.81
110	230	0.61	1690	1805	1919	±10.4
120	248	0.58	1791	1915	2039	±11.28
125	257	0.55	1840	1970	2099	±11.91
130	266	0.52	1889	2023	2158	±12.72
140	284	0.45	1980	2124	2269	±15.21
150	302	0.35	2057	2211	2365	±20.09

Table 10. Ambient temperature, corresponding resistance, temperature coefficient and maximum expected temperature error for KTY81/210 and KTY81/220

$I_{sen(cont)} = 1\text{ mA}$.

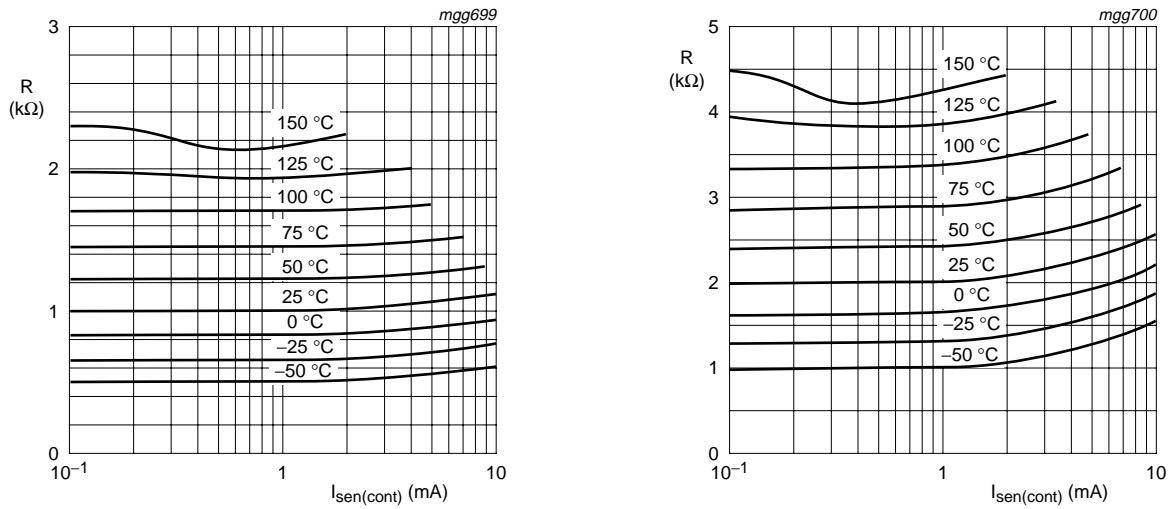
Ambient temperature		Temperature coefficient (%/K)	KTY81/210				KTY81/220			
(°C)	(°F)		Resistance (Ω)			Temperature error (K)	Resistance (Ω)			Temperature error (K)
			Min	Typ	Max		Min	Typ	Max	
-55	-67	0.99	951	980	1009	±3.02	941	980	1019	±4.02
-50	-58	0.98	1000	1030	1059	±2.92	990	1030	1070	±3.94
-40	-40	0.96	1105	1135	1165	±2.74	1094	1135	1176	±3.78
-30	-22	0.93	1218	1247	1277	±2.55	1205	1247	1289	±3.62
-20	-4	0.91	1338	1367	1396	±2.35	1325	1367	1410	±3.45
-10	14	0.88	1467	1495	1523	±2.14	1452	1495	1538	±3.27
0	32	0.85	1603	1630	1656	±1.91	1587	1630	1673	±3.08
10	50	0.83	1748	1772	1797	±1.67	1730	1772	1814	±2.88
20	68	0.80	1901	1922	1944	±1.41	1881	1922	1963	±2.66
25	77	0.79	1980	2000	2020	±1.27	1960	2000	2040	±2.54
30	86	0.78	2057	2080	2102	±1.39	2036	2080	2123	±2.68
40	104	0.75	2217	2245	2272	±1.64	2194	2245	2295	±2.97
50	122	0.73	2383	2417	2451	±1.91	2359	2417	2475	±3.28
60	140	0.71	2557	2597	2637	±2.19	2531	2597	2663	±3.61
70	158	0.69	2737	2785	2832	±2.49	2709	2785	2860	±3.94
80	176	0.67	2924	2980	3035	±2.8	2894	2980	3065	±4.3
90	194	0.65	3118	3182	3246	±3.12	3086	3182	3278	±4.66
100	212	0.63	3318	3392	3466	±3.46	3284	3392	3500	±5.05
110	230	0.59	3523	3607	3691	±3.93	3487	3607	3728	±5.61
120	248	0.53	3722	3817	3912	±4.7	3683	3817	3950	±6.59
125	257	0.49	3815	3915	4016	±5.26	3775	3915	4055	±7.31
130	266	0.44	3901	4008	4114	±6	3861	4008	4154	±8.27
140	284	0.33	4049	4166	4283	±8.45	4008	4166	4325	±11.46
150	302	0.20	4153	4280	4407	±14.63	4110	4280	4450	±19.56

Table 11. Ambient temperature, corresponding resistance, temperature coefficient and maximum expected temperature error for KTY81/221 and KTY81/222 $I_{sen(cont)} = 1 \text{ mA}$.

Ambient temperature		Temperature coefficient (%/K)	KTY81/221				KTY81/222			
(°C)	(°F)		Resistance (Ω)			Temperature error (K)	Resistance (Ω)			Temperature error (K)
			Min	Typ	Max		Min	Typ	Max	
-55	-67	0.99	941	970	999	±3.02	960	990	1020	±3.02
-50	-58	0.98	990	1019	1049	±2.92	1010	1040	1070	±2.92
-40	-40	0.96	1094	1123	1153	±2.74	1116	1146	1176	±2.74
-30	-22	0.93	1205	1235	1264	±2.55	1230	1260	1290	±2.55
-20	-4	0.91	1325	1354	1382	±2.35	1352	1381	1410	±2.35
-10	14	0.88	1452	1480	1508	±2.14	1481	1510	1538	±2.14
0	32	0.85	1587	1613	1640	±1.91	1619	1646	1673	±1.91
10	50	0.83	1730	1754	1779	±1.67	1765	1790	1815	±1.67
20	68	0.80	1882	1903	1924	±1.41	1920	1941	1963	±1.41
25	77	0.79	1960	1980	2000	±1.27	2000	2020	2040	±1.27
30	86	0.78	2037	2059	2081	±1.39	2078	2100	2123	±1.39
40	104	0.75	2195	2222	2250	±1.64	2239	2267	2295	±1.64
50	122	0.73	2360	2393	2426	±1.91	2407	2441	2475	±1.91
60	140	0.71	2531	2571	2611	±2.19	2582	2623	2664	±2.19
70	158	0.69	2710	2757	2804	±2.49	2764	2812	2860	±2.49
80	176	0.67	2895	2950	3005	±2.8	2953	3009	3065	±2.8
90	194	0.65	3086	3150	3214	±3.12	3149	3214	3279	±3.12
100	212	0.63	3285	3358	3431	±3.46	3351	3426	3501	±3.46
110	230	0.59	3488	3571	3655	±3.93	3558	3643	3728	±3.93
120	248	0.53	3684	3779	3873	±4.7	3759	3855	3951	±4.7
125	257	0.49	3776	3876	3976	±5.26	3853	3955	4056	±5.26
130	266	0.44	3862	3967	4073	±6	3940	4048	4155	±6
140	284	0.33	4009	4125	4241	±8.45	4090	4208	4326	±8.45
150	302	0.20	4112	4237	4363	±14.63	4195	4323	4451	±14.63

Table 12. Ambient temperature, corresponding resistance, temperature coefficient and maximum expected temperature error for KTY81/250 $I_{sen(cont)} = 1\text{ mA}$.

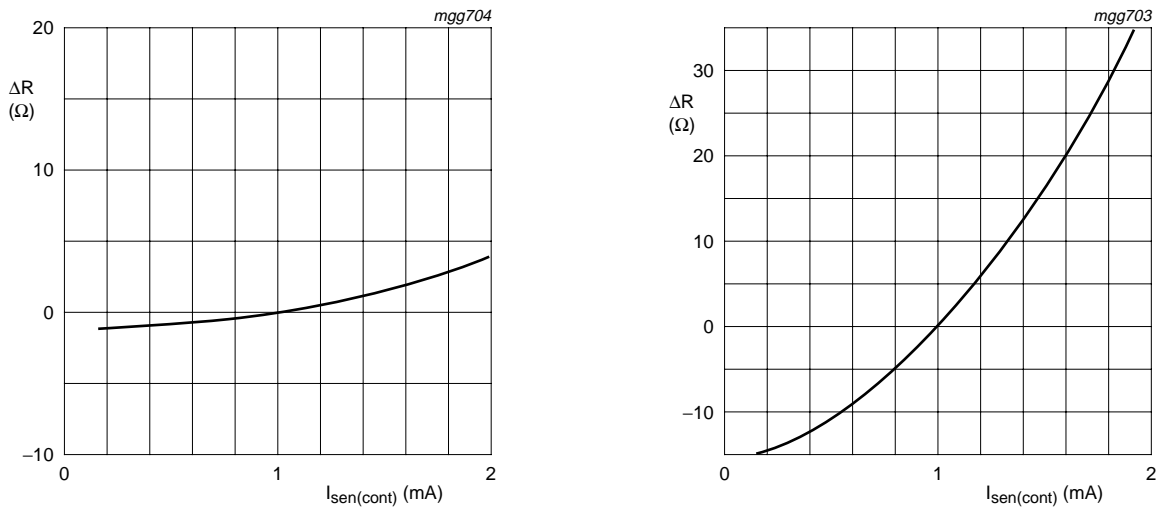
Ambient temperature		Temperature coefficient (%/K)	KTY81/250			
(°C)	(°F)		Resistance (Ω)			Temperature error (K)
			Min	Typ	Max	
-55	-67	0.99	911	980	1049	± 7.04
-50	-58	0.98	959	1030	1101	± 6.99
-40	-40	0.96	1060	1135	1210	± 6.91
-30	-22	0.93	1168	1247	1327	± 6.84
-20	-4	0.91	1283	1367	1451	± 6.77
-10	14	0.88	1407	1495	1583	± 6.69
0	32	0.85	1538	1630	1721	± 6.61
10	50	0.83	1677	1772	1867	± 6.51
20	68	0.80	1824	1922	2021	± 6.41
25	77	0.79	1900	2000	2100	± 6.35
30	86	0.78	1974	2080	2185	± 6.55
40	104	0.75	2127	2245	2362	± 6.97
50	122	0.73	2287	2417	2547	± 7.4
60	140	0.71	2453	2597	2741	± 7.85
70	158	0.69	2626	2785	2943	± 8.31
80	176	0.67	2805	2980	3154	± 8.79
90	194	0.65	2990	3182	3374	± 9.29
100	212	0.63	3182	3392	3602	± 9.81
110	230	0.59	3379	3607	3836	± 10.65
120	248	0.53	3569	3817	4065	± 12.25
125	257	0.49	3658	3915	4173	± 13.45
130	266	0.44	3741	4008	4274	± 15.06
140	284	0.33	3883	4166	4450	± 20.49
150	302	0.20	3982	4280	4578	± 34.35



To keep the temperature error low, an operating current of $I_{sen(cont)} = 1 \text{ mA}$ is recommended for temperatures above $100 \text{ }^\circ\text{C}$

- a. KTY81/1 series
- b. KTY81/2 series

Fig 1. Sensor resistance as a function of operating current



$T_{amb} = 25 \text{ }^\circ\text{C}$

- a. KTY81/1 series

$T_{amb} = 25 \text{ }^\circ\text{C}$

- b. KTY81/2 series

Fig 2. Deviation of sensor resistance as a function of operating current

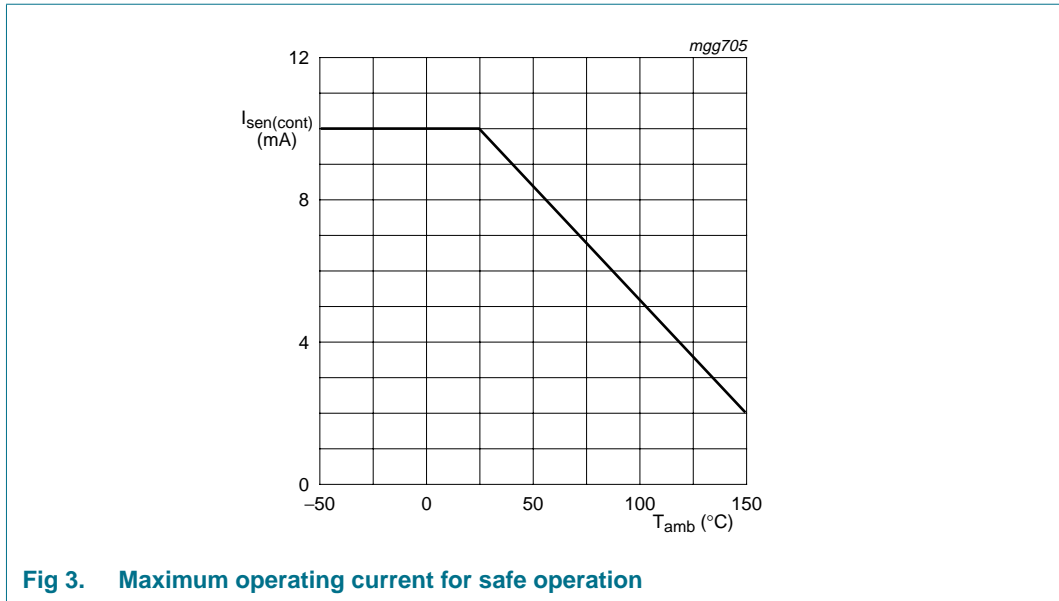


Fig 3. Maximum operating current for safe operation

7. Package outline

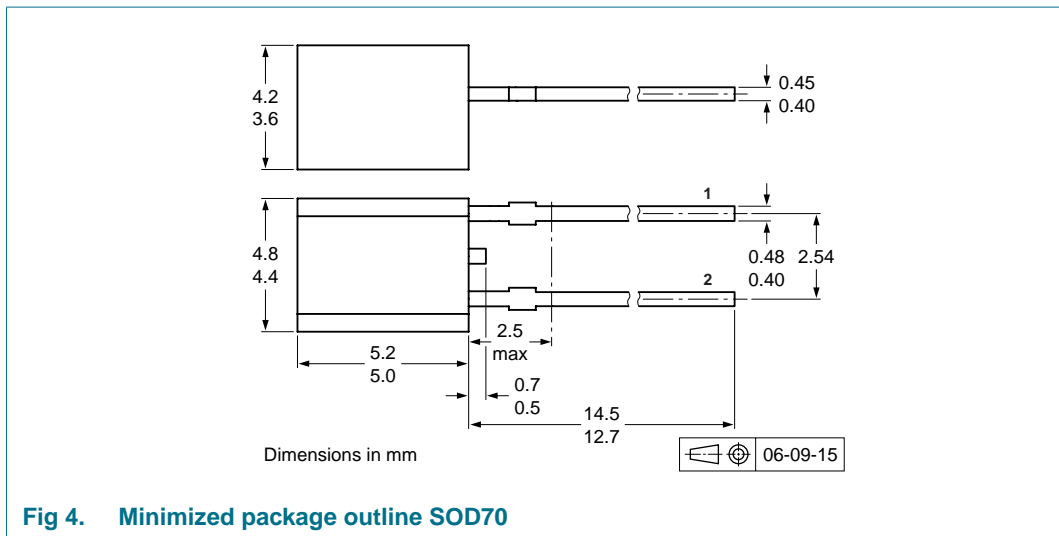


Fig 4. Minimized package outline SOD70

8. Packing information

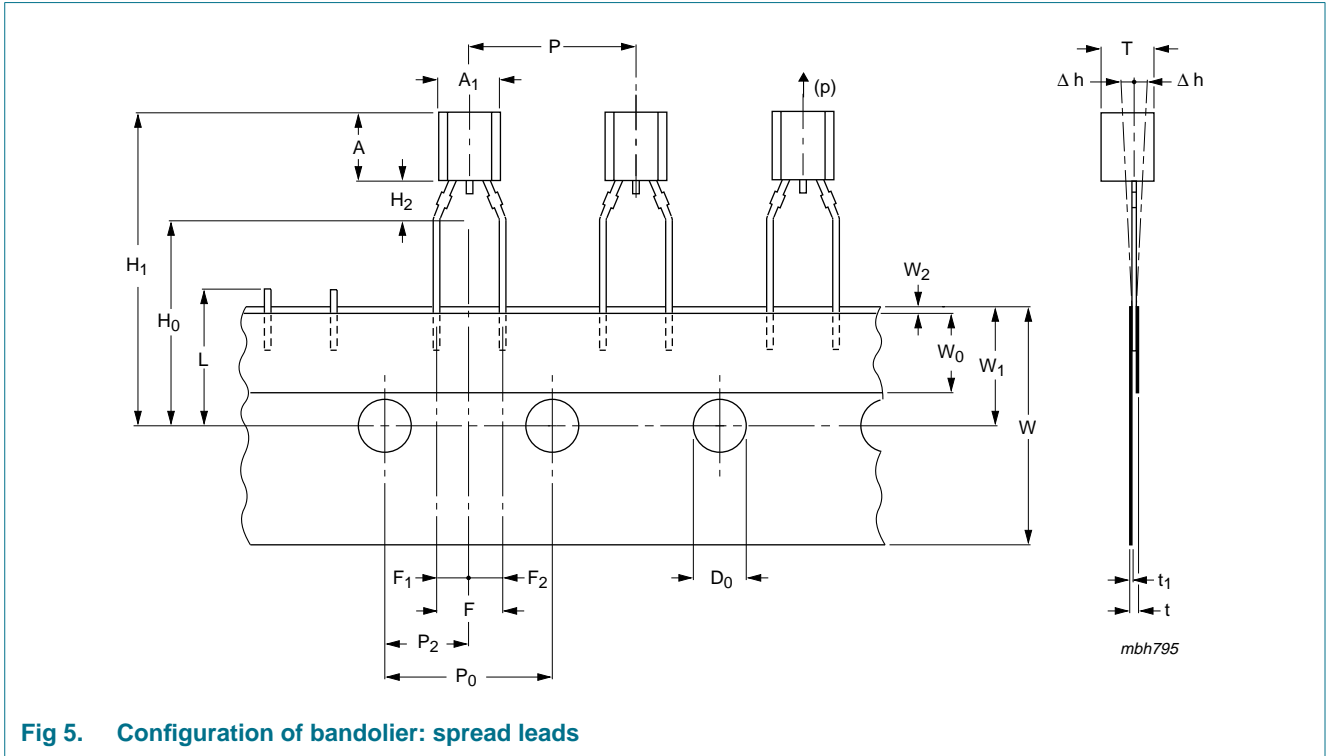


Fig 5. Configuration of bandolier: spread leads

Note: Types in bulk packaging have a lead-to-lead distance of 2.54 mm (see [Figure 4](#)). The lead-to-lead distance of types packaged on reel have a lead-to-lead distance of 5.08 mm, spread leads (see [Figure 5](#)).

Table 13. Tape specification

Symbol	Dimension	Specifications					Remarks
		Min	Typ	Max	Tolerance	Unit	
A ₁	body width	4.4	-	4.8	-	mm	
A	body height	5	-	5.2	-	mm	
T	body thickness	3.6	-	4.2	-	mm	
P	pitch of component	-	12.7	-	±1	mm	
P ₀	feed hole pitch	-	12.7	-	±0.3	mm	
	cumulative pitch error	-1	-	+1	-	mm	measured over 20 devices
P ₂	feed hole center to component center	-	6.35	-	±0.4	mm	to be measured at bottom of clinch
F	lead-to-lead distance	-	5.08	-	+0.6/-0.2	mm	spread leads
Δh	component alignment	-	0	1	-	mm	at top of body
W	tape width	-	18	-	±0.5	mm	
W ₀	hold-down tape width	-	6	-	±0.2	mm	
W ₁	hole position	-	9	-	+0.7/-0.5	mm	
W ₂	hold-down tape position	-	0.5	-	±0.2	mm	
H ₀	lead wire clinch height	-	16.5	-	±0.5	mm	
H ₁	component height	-	-	23.25	-	mm	
L	length of snipped leads	-	-	11	-	mm	
D ₀	feed hole diameter	-	4	-	±0.2	mm	
t	total tape thickness	-	-	1.2	-	mm	t ₁ = 0.3 mm to 0.6 mm
F ₁ , F ₂	lead to snipped lead distance	-	2.54	-	+0.4/-0.2	mm	spread leads
H ₂	clinch height	-	2.5	-	+0.5/0	mm	
(p)	pull-out force	6	-	-	-	N	

9. Revision history

Table 14. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
KTY81_SER_5	20080425	Product data sheet	-	KTY81-2SERIES_4 KTY81-1SERIES_3
Modifications:				
				<ul style="list-style-type: none"> The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors. Legal texts have been adapted to the new company name where appropriate.
KTY81-2SERIES_4	20000825	Product specification	-	-
KTY81-1SERIES_3	20000825	Product specification	-	-

10. Legal information

10.1 Data sheet status

Document status ^{[1][2]}	Product status ^[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nxp.com>.

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Základní hodnoty termoelektrického napětí [mV] --termočlánek "J" (Fe-CuNi)

Dle ČSN EN 60584-1 (ITS-90) pro referenční teplotu 0 °C

°C	0	1	2	3	4	5	6	7	8	9	10	°C
-210	-8,095	-8,076	-8,057	-8,037	-8,017	-7,996	-7,976	-7,955	-7,934	-7,912	-7,890	-210
-200	-7,890	-7,868	-7,846	-7,824	-7,801	-7,778	-7,755	-7,731	-7,707	-7,683	-7,659	-200
-190	-7,659	-7,634	-7,610	-7,585	-7,559	-7,534	-7,508	-7,482	-7,456	-7,429	-7,403	-190
-180	-7,403	-7,376	-7,348	-7,321	-7,293	-7,265	-7,237	-7,209	-7,181	-7,152	-7,123	-180
-170	-7,123	-7,094	-7,064	-7,035	-7,005	-6,975	-6,944	-6,914	-6,883	-6,853	-6,821	-170
-160	-6,821	-6,790	-6,759	-6,727	-6,695	-6,663	-6,631	-6,598	-6,566	-6,533	-6,500	-160
-150	-6,500	-6,467	-6,433	-6,400	-6,366	-6,332	-6,298	-6,263	-6,229	-6,194	-6,159	-150
-140	-6,159	-6,124	-6,089	-6,054	-6,018	-5,982	-5,946	-5,910	-5,874	-5,838	-5,801	-140
-130	-5,801	-5,764	-5,727	-5,690	-5,653	-5,616	-5,578	-5,541	-5,503	-5,465	-5,426	-130
-120	-5,426	-5,388	-5,350	-5,311	-5,272	-5,233	-5,194	-5,155	-5,116	-5,076	-5,037	-120
-110	-5,037	-4,997	-4,957	-4,917	-4,877	-4,836	-4,796	-4,755	-4,714	-4,674	-4,633	-110
-100	-4,633	-4,591	-4,550	-4,509	-4,467	-4,425	-4,384	-4,342	-4,300	-4,257	-4,215	-100
-90	-4,215	-4,173	-4,130	-4,088	-4,045	-4,002	-3,959	-3,916	-3,872	-3,829	-3,786	-90
-80	-3,786	-3,742	-3,698	-3,654	-3,610	-3,566	-3,522	-3,478	-3,434	-3,389	-3,344	-80
-70	-3,344	-3,300	-3,255	-3,210	-3,165	-3,120	-3,075	-3,029	-2,984	-2,938	-2,893	-70
-60	-2,893	-2,847	-2,801	-2,755	-2,709	-2,663	-2,617	-2,571	-2,524	-2,478	-2,431	-60
-50	-2,431	-2,385	-2,338	-2,291	-2,244	-2,197	-2,150	-2,103	-2,055	-2,008	-1,961	-50
-40	-1,961	-1,913	-1,865	-1,818	-1,770	-1,722	-1,674	-1,626	-1,578	-1,530	-1,482	-40
-30	-1,482	-1,433	-1,385	-1,336	-1,288	-1,239	-1,190	-1,142	-1,093	-1,044	-0,995	-30
-20	-0,995	-0,946	-0,896	-0,847	-0,798	-0,749	-0,699	-0,650	-0,600	-0,550	-0,501	-20
-10	-0,501	-0,451	-0,401	-0,351	-0,301	-0,251	-0,201	-0,151	-0,101	-0,050	0,000	-10
0	0,000	0,050	0,101	0,151	0,202	0,253	0,303	0,354	0,405	0,456	0,507	0
10	0,507	0,558	0,609	0,660	0,711	0,762	0,814	0,865	0,916	0,968	1,019	10
20	1,019	1,071	1,122	1,174	1,226	1,277	1,329	1,381	1,433	1,485	1,537	20
30	1,537	1,589	1,641	1,693	1,745	1,797	1,849	1,902	1,954	2,006	2,059	30
40	2,059	2,111	2,164	2,216	2,269	2,322	2,374	2,427	2,480	2,532	2,585	40
50	2,585	2,638	2,691	2,744	2,797	2,850	2,903	2,956	3,009	3,062	3,116	50
60	3,116	3,169	3,222	3,275	3,329	3,382	3,436	3,489	3,543	3,596	3,650	60
70	3,650	3,703	3,757	3,810	3,864	3,918	3,971	4,025	4,079	4,133	4,187	70
80	4,187	4,240	4,294	4,348	4,402	4,456	4,510	4,564	4,618	4,672	4,726	80
90	4,726	4,781	4,835	4,889	4,943	4,997	5,052	5,106	5,160	5,215	5,269	90
100	5,269	5,323	5,378	5,432	5,487	5,541	5,595	5,650	5,705	5,759	5,814	100
110	5,814	5,868	5,923	5,977	6,032	6,087	6,141	6,196	6,251	6,306	6,360	110
120	6,360	6,415	6,470	6,525	6,579	6,634	6,689	6,744	6,799	6,854	6,909	120
130	6,909	6,964	7,019	7,074	7,129	7,184	7,239	7,294	7,349	7,404	7,459	130
140	7,459	7,514	7,569	7,624	7,679	7,734	7,789	7,844	7,900	7,955	8,010	140
150	8,010	8,065	8,120	8,175	8,231	8,286	8,341	8,396	8,452	8,507	8,562	150
160	8,562	8,618	8,673	8,728	8,783	8,839	8,894	8,949	9,005	9,060	9,115	160
170	9,115	9,171	9,226	9,282	9,337	9,392	9,448	9,503	9,559	9,614	9,669	170
180	9,669	9,725	9,780	9,836	9,891	9,947	10,002	10,057	10,113	10,168	10,224	180
190	10,224	10,279	10,335	10,390	10,446	10,501	10,557	10,612	10,668	10,723	10,779	190
200	10,779	10,834	10,890	10,945	11,001	11,056	11,112	11,167	11,223	11,278	11,334	200
210	11,334	11,389	11,445	11,501	11,556	11,612	11,667	11,723	11,778	11,834	11,889	210
220	11,889	11,945	12,000	12,056	12,111	12,167	12,222	12,278	12,334	12,389	12,445	220
230	12,445	12,500	12,556	12,611	12,667	12,722	12,778	12,833	12,889	12,944	13,000	230
240	13,000	13,056	13,111	13,167	13,222	13,278	13,333	13,389	13,444	13,500	13,555	240
250	13,555	13,611	13,666	13,722	13,777	13,833	13,888	13,944	13,999	14,055	14,110	250
260	14,110	14,166	14,221	14,277	14,332	14,388	14,443	14,499	14,554	14,609	14,665	260
270	14,665	14,720	14,776	14,831	14,887	14,942	14,998	15,053	15,109	15,164	15,219	270
280	15,219	15,275	15,330	15,386	15,441	15,496	15,552	15,607	15,663	15,718	15,773	280
290	15,773	15,829	15,884	15,940	15,995	16,050	16,106	16,161	16,216	16,272	16,327	290
300	16,327	16,383	16,438	16,493	16,549	16,604	16,659	16,715	16,770	16,825	16,881	300
310	16,881	16,936	16,991	17,046	17,102	17,157	17,212	17,268	17,323	17,378	17,434	310
320	17,434	17,489	17,544	17,599	17,655	17,710	17,765	17,820	17,876	17,931	17,986	320
330	17,986	18,041	18,097	18,152	18,207	18,262	18,318	18,373	18,428	18,483	18,538	330
340	18,538	18,594	18,649	18,704	18,759	18,814	18,870	18,925	18,980	19,035	19,090	340
350	19,090	19,146	19,201	19,256	19,311	19,366	19,422	19,477	19,532	19,587	19,642	350
360	19,642	19,697	19,753	19,808	19,863	19,918	19,973	20,028	20,083	20,139	20,194	360
370	20,194	20,249	20,304	20,359	20,414	20,469	20,525	20,580	20,635	20,690	20,745	370
380	20,745	20,800	20,855	20,911	20,966	21,021	21,076	21,131	21,186	21,241	21,297	380
390	21,297	21,352	21,407	21,462	21,517	21,572	21,627	21,683	21,738	21,793	21,848	390
400	21,848	21,903	21,958	22,014	22,069	22,124	22,179	22,234	22,289	22,345	22,400	400
410	22,400	22,455	22,510	22,565	22,620	22,676	22,731	22,786	22,841	22,896	22,952	410
420	22,952	23,007	23,062	23,117	23,172	23,228	23,283	23,338	23,393	23,449	23,504	420
430	23,504	23,559	23,614	23,670	23,725	23,780	23,835	23,891	23,946	24,001	24,057	430
440	24,057	24,112	24,167	24,223	24,278	24,333	24,389	24,444	24,499	24,555	24,610	440
450	24,610	24,665	24,721	24,776	24,832	24,887	24,943	24,998	25,053	25,109	25,164	450
460	25,164	25,220	25,275	25,331	25,386	25,442	25,497	25,553	25,608	25,664	25,720	460
470	25,720	25,775	25,831	25,886	25,942	25,998	26,053	26,109	26,165	26,220	26,276	470
480	26,276	26,332	26,387	26,443	26,499	26,555	26,610	26,666	26,722	26,778	26,834	480

Termoelektrické napětí - termočlánek "J"

°C	0	1	2	3	4	5	6	7	8	9	10	°C
490	26,834	26,889	26,945	27,001	27,057	27,113	27,169	27,225	27,281	27,337	27,393	490
500	27,393	27,449	27,505	27,561	27,617	27,673	27,729	27,785	27,841	27,897	27,953	500
510	27,953	28,010	28,066	28,122	28,178	28,234	28,291	28,347	28,403	28,460	28,516	510
520	28,516	28,572	28,629	28,685	28,741	28,798	28,854	28,911	28,967	29,024	29,080	520
530	29,080	29,137	29,194	29,250	29,307	29,363	29,420	29,477	29,534	29,590	29,647	530
540	29,647	29,704	29,761	29,818	29,874	29,931	29,988	30,045	30,102	30,159	30,216	540
550	30,216	30,273	30,330	30,387	30,444	30,502	30,559	30,616	30,673	30,730	30,788	550
560	30,788	30,845	30,902	30,960	31,017	31,074	31,132	31,189	31,247	31,304	31,362	560
570	31,362	31,419	31,477	31,535	31,592	31,650	31,708	31,766	31,823	31,881	31,939	570
580	31,939	31,997	32,055	32,113	32,171	32,229	32,287	32,345	32,403	32,461	32,519	580
590	32,519	32,577	32,636	32,694	32,752	32,810	32,869	32,927	32,985	33,044	33,102	590
600	33,102	33,161	33,219	33,278	33,337	33,395	33,454	33,513	33,571	33,630	33,689	600
610	33,689	33,748	33,807	33,866	33,925	33,984	34,043	34,102	34,161	34,220	34,279	610
620	34,279	34,338	34,397	34,457	34,516	34,575	34,635	34,694	34,754	34,813	34,873	620
630	34,873	34,932	34,992	35,051	35,111	35,171	35,230	35,290	35,350	35,410	35,470	630
640	35,470	35,530	35,590	35,650	35,710	35,770	35,830	35,890	35,950	36,010	36,071	640
650	36,071	36,131	36,191	36,252	36,312	36,373	36,433	36,494	36,554	36,615	36,675	650
660	36,675	36,736	36,797	36,858	36,918	36,979	37,040	37,101	37,162	37,223	37,284	660
670	37,284	37,345	37,406	37,467	37,528	37,590	37,651	37,712	37,773	37,835	37,896	670
680	37,896	37,958	38,019	38,081	38,142	38,204	38,265	38,327	38,389	38,450	38,512	680
690	38,512	38,574	38,636	38,698	38,760	38,822	38,884	38,946	39,008	39,070	39,132	690
700	39,132	39,194	39,256	39,318	39,381	39,443	39,505	39,568	39,630	39,693	39,755	700
710	39,755	39,818	39,880	39,943	40,005	40,068	40,131	40,193	40,256	40,319	40,382	710
720	40,382	40,445	40,508	40,570	40,633	40,696	40,759	40,822	40,886	40,949	41,012	720
730	41,012	41,075	41,138	41,201	41,265	41,328	41,391	41,455	41,518	41,581	41,645	730
740	41,645	41,708	41,772	41,835	41,899	41,962	42,026	42,090	42,153	42,217	42,281	740
750	42,281	42,344	42,408	42,472	42,536	42,599	42,663	42,727	42,791	42,855	42,919	750
760	42,919	42,983	43,047	43,111	43,175	43,239	43,303	43,367	43,431	43,495	43,559	760
770	43,559	43,624	43,688	43,752	43,817	43,881	43,945	44,010	44,074	44,139	44,203	770
780	44,203	44,267	44,332	44,396	44,461	44,525	44,590	44,655	44,719	44,784	44,848	780
790	44,848	44,913	44,977	45,042	45,107	45,171	45,236	45,301	45,365	45,430	45,494	790
800	45,494	45,559	45,624	45,688	45,753	45,818	45,882	45,947	46,011	46,076	46,141	800
810	46,141	46,205	46,270	46,334	46,399	46,464	46,528	46,593	46,657	46,722	46,786	810
820	46,786	46,851	46,915	46,980	47,044	47,109	47,173	47,238	47,302	47,367	47,431	820
830	47,431	47,495	47,560	47,624	47,688	47,753	47,817	47,881	47,946	48,010	48,074	830
840	48,074	48,138	48,202	48,267	48,331	48,395	48,459	48,523	48,587	48,651	48,715	840
850	48,715	48,779	48,843	48,907	48,971	49,034	49,098	49,162	49,226	49,290	49,353	850
860	49,353	49,417	49,481	49,544	49,608	49,672	49,735	49,799	49,862	49,926	49,989	860
870	49,989	50,052	50,116	50,179	50,243	50,306	50,369	50,432	50,495	50,559	50,622	870
880	50,622	50,685	50,748	50,811	50,874	50,937	51,000	51,063	51,126	51,188	51,251	880
890	51,251	51,314	51,377	51,439	51,502	51,565	51,627	51,690	51,752	51,815	51,877	890
900	51,877	51,940	52,002	52,064	52,127	52,189	52,251	52,314	52,376	52,438	52,500	900
910	52,500	52,562	52,624	52,686	52,748	52,810	52,872	52,934	52,996	53,057	53,119	910
920	53,119	53,181	53,243	53,304	53,366	53,427	53,489	53,550	53,612	53,673	53,735	920
930	53,735	53,796	53,857	53,919	53,980	54,041	54,102	54,164	54,225	54,286	54,347	930
940	54,347	54,408	54,469	54,530	54,591	54,652	54,713	54,773	54,834	54,895	54,956	940
950	54,956	55,016	55,077	55,138	55,198	55,259	55,319	55,380	55,440	55,501	55,561	950
960	55,561	55,622	55,682	55,742	55,803	55,863	55,923	55,983	56,043	56,104	56,164	960
970	56,164	56,224	56,284	56,344	56,404	56,464	56,524	56,584	56,644	56,704	56,763	970
980	56,763	56,823	56,883	56,942	57,002	57,062	57,121	57,181	57,240	57,300	57,360	980
990	57,360	57,419	57,479	57,538	57,597	57,657	57,716	57,776	57,835	57,894	57,953	990
1000	57,953	58,013	58,072	58,131	58,190	58,249	58,309	58,368	58,427	58,486	58,545	1000
1010	58,545	58,604	58,663	58,722	58,781	58,840	58,899	58,957	59,016	59,075	59,134	1010
1020	59,134	59,193	59,252	59,310	59,369	59,428	59,487	59,545	59,604	59,663	59,721	1020
1030	59,721	59,780	59,838	59,897	59,956	60,014	60,073	60,131	60,190	60,248	60,307	1030
1040	60,307	60,365	60,423	60,482	60,540	60,599	60,657	60,715	60,774	60,832	60,890	1040
1050	60,890	60,949	61,007	61,065	61,123	61,182	61,240	61,298	61,356	61,415	61,473	1050
1060	61,473	61,531	61,589	61,647	61,705	61,763	61,822	61,880	61,938	61,996	62,054	1060
1070	62,054	62,112	62,170	62,228	62,286	62,344	62,402	62,460	62,518	62,576	62,634	1070
1080	62,634	62,692	62,750	62,808	62,866	62,924	62,982	63,040	63,098	63,156	63,214	1080
1090	63,214	63,271	63,329	63,387	63,445	63,503	63,561	63,619	63,677	63,734	63,792	1090
1100	63,792	63,850	63,908	63,966	64,024	64,081	64,139	64,197	64,255	64,313	64,370	1100
1110	64,370	64,428	64,486	64,544	64,602	64,659	64,717	64,775	64,833	64,890	64,948	1110
1120	64,948	65,006	65,064	65,121	65,179	65,237	65,295	65,352	65,410	65,468	65,525	1120
1130	65,525	65,583	65,641	65,699	65,756	65,814	65,872	65,929	65,987	66,045	66,102	1130
1140	66,102	66,160	66,218	66,275	66,333	66,391	66,448	66,506	66,564	66,621	66,679	1140
1150	66,679	66,737	66,794	66,852	66,910	66,967	67,025	67,082	67,140	67,198	67,255	1150
1160	67,255	67,313	67,370	67,428	67,486	67,543	67,601	67,658	67,716	67,773	67,831	1160
1170	67,831	67,888	67,946	68,003	68,061	68,119	68,176	68,234	68,291	68,348	68,406	1170
1180	68,406	68,463	68,521	68,578	68,636	68,693	68,751	68,808	68,865	68,923	68,980	1180
1190	68,980	69,037	69,095	69,152	69,209	69,267	69,324	69,381	69,439	69,496	69,553	1190

$$U_T = \text{tab}(t_M) - \text{tab}(t_S)$$

U_T ... napětí na termočlánek [mV]

t_M ... měřená teplota [°C]

t_S ... srovnávací teplota [°C]

tab() ... hodnota v tabulce pro určitou teplotu a určitý typ termočlánek [°C]

Základní hodnoty termoelektrického napětí [mV] --termočlánek "K" (NiCr-NiAl)

Dle ČSN EN 60584-1 (ITS-90) pro referenční teplotu 0 °C

°C	0	1	2	3	4	5	6	7	8	9	10	°C
-270	-6,458	-6,457	-6,456	-6,455	-6,453	-6,452	-6,450	-6,448	-6,446	-6,444	-6,441	-270
-260	-6,441	-6,438	-6,435	-6,432	-6,429	-6,425	-6,421	-6,417	-6,413	-6,408	-6,404	-260
-250	-6,404	-6,399	-6,393	-6,388	-6,382	-6,377	-6,370	-6,364	-6,358	-6,351	-6,344	-250
-240	-6,344	-6,337	-6,329	-6,322	-6,314	-6,306	-6,297	-6,289	-6,280	-6,271	-6,262	-240
-230	-6,262	-6,252	-6,243	-6,233	-6,223	-6,213	-6,202	-6,192	-6,181	-6,170	-6,158	-230
-220	-6,158	-6,147	-6,135	-6,123	-6,111	-6,099	-6,087	-6,074	-6,061	-6,048	-6,035	-220
-210	-6,035	-6,021	-6,007	-5,994	-5,980	-5,965	-5,951	-5,936	-5,922	-5,907	-5,891	-210
-200	-5,891	-5,876	-5,861	-5,845	-5,829	-5,813	-5,797	-5,780	-5,763	-5,747	-5,730	-200
-190	-5,730	-5,713	-5,695	-5,678	-5,660	-5,642	-5,624	-5,606	-5,588	-5,569	-5,550	-190
-180	-5,550	-5,531	-5,512	-5,493	-5,474	-5,454	-5,435	-5,415	-5,395	-5,374	-5,354	-180
-170	-5,354	-5,333	-5,313	-5,292	-5,271	-5,250	-5,228	-5,207	-5,185	-5,163	-5,141	-170
-160	-5,141	-5,119	-5,097	-5,074	-5,052	-5,029	-5,006	-4,983	-4,960	-4,936	-4,913	-160
-150	-4,913	-4,889	-4,865	-4,841	-4,817	-4,793	-4,768	-4,744	-4,719	-4,694	-4,669	-150
-140	-4,669	-4,644	-4,618	-4,593	-4,567	-4,542	-4,516	-4,490	-4,463	-4,437	-4,411	-140
-130	-4,411	-4,384	-4,357	-4,330	-4,303	-4,276	-4,249	-4,221	-4,194	-4,166	-4,138	-130
-120	-4,138	-4,110	-4,082	-4,054	-4,025	-3,997	-3,968	-3,939	-3,911	-3,882	-3,852	-120
-110	-3,852	-3,823	-3,794	-3,764	-3,734	-3,705	-3,675	-3,645	-3,614	-3,584	-3,554	-110
-100	-3,554	-3,523	-3,492	-3,462	-3,431	-3,400	-3,368	-3,337	-3,306	-3,274	-3,243	-100
-90	-3,243	-3,211	-3,179	-3,147	-3,115	-3,083	-3,050	-3,018	-2,986	-2,953	-2,920	-90
-80	-2,920	-2,887	-2,854	-2,821	-2,788	-2,755	-2,721	-2,688	-2,654	-2,620	-2,587	-80
-70	-2,587	-2,553	-2,519	-2,485	-2,450	-2,416	-2,382	-2,347	-2,312	-2,278	-2,243	-70
-60	-2,243	-2,208	-2,173	-2,138	-2,103	-2,067	-2,032	-1,996	-1,961	-1,925	-1,889	-60
-50	-1,889	-1,854	-1,818	-1,782	-1,745	-1,709	-1,673	-1,637	-1,600	-1,564	-1,527	-50
-40	-1,527	-1,490	-1,453	-1,417	-1,380	-1,343	-1,305	-1,268	-1,231	-1,194	-1,156	-40
-30	-1,156	-1,119	-1,081	-1,043	-1,006	-0,968	-0,930	-0,892	-0,854	-0,816	-0,778	-30
-20	-0,778	-0,739	-0,701	-0,663	-0,624	-0,586	-0,547	-0,508	-0,470	-0,431	-0,392	-20
-10	-0,392	-0,353	-0,314	-0,275	-0,236	-0,197	-0,157	-0,118	-0,079	-0,039	0,000	-10
0	0,000	0,039	0,079	0,119	0,158	0,198	0,238	0,277	0,317	0,357	0,397	0
10	0,397	0,437	0,477	0,517	0,557	0,597	0,637	0,677	0,718	0,758	0,798	10
20	0,798	0,838	0,879	0,919	0,960	1,000	1,041	1,081	1,122	1,163	1,203	20
30	1,203	1,244	1,285	1,326	1,366	1,407	1,448	1,489	1,530	1,571	1,612	30
40	1,612	1,653	1,694	1,735	1,776	1,817	1,858	1,899	1,941	1,982	2,023	40
50	2,023	2,064	2,106	2,147	2,188	2,230	2,271	2,312	2,354	2,395	2,436	50
60	2,436	2,478	2,519	2,561	2,602	2,644	2,685	2,727	2,768	2,810	2,851	60
70	2,851	2,893	2,934	2,976	3,017	3,059	3,100	3,142	3,184	3,225	3,267	70
80	3,267	3,308	3,350	3,391	3,433	3,474	3,516	3,557	3,599	3,640	3,682	80
90	3,682	3,723	3,765	3,806	3,848	3,889	3,931	3,972	4,013	4,055	4,096	90
100	4,096	4,138	4,179	4,220	4,262	4,303	4,344	4,385	4,427	4,468	4,509	100
110	4,509	4,550	4,591	4,633	4,674	4,715	4,756	4,797	4,838	4,879	4,920	110
120	4,920	4,961	5,002	5,043	5,084	5,124	5,165	5,206	5,247	5,288	5,328	120
130	5,328	5,369	5,410	5,450	5,491	5,532	5,572	5,613	5,653	5,694	5,735	130
140	5,735	5,775	5,815	5,856	5,896	5,937	5,977	6,017	6,058	6,098	6,138	140
150	6,138	6,179	6,219	6,259	6,299	6,339	6,380	6,420	6,460	6,500	6,540	150
160	6,540	6,580	6,620	6,660	6,701	6,741	6,781	6,821	6,861	6,901	6,941	160
170	6,941	6,981	7,021	7,060	7,100	7,140	7,180	7,220	7,260	7,300	7,340	170
180	7,340	7,380	7,420	7,460	7,500	7,540	7,579	7,619	7,659	7,699	7,739	180
190	7,739	7,779	7,819	7,859	7,899	7,939	7,979	8,019	8,059	8,099	8,138	190
200	8,138	8,178	8,218	8,258	8,298	8,338	8,378	8,418	8,458	8,499	8,539	200
210	8,539	8,579	8,619	8,659	8,699	8,739	8,779	8,819	8,860	8,900	8,940	210
220	8,940	8,980	9,020	9,061	9,101	9,141	9,181	9,222	9,262	9,302	9,343	220
230	9,343	9,383	9,423	9,464	9,504	9,545	9,585	9,626	9,666	9,707	9,747	230
240	9,747	9,788	9,828	9,869	9,909	9,950	9,991	10,031	10,072	10,113	10,153	240
250	10,153	10,194	10,235	10,276	10,316	10,357	10,398	10,439	10,480	10,520	10,561	250
260	10,561	10,602	10,643	10,684	10,725	10,766	10,807	10,848	10,889	10,930	10,971	260
270	10,971	11,012	11,053	11,094	11,135	11,176	11,217	11,259	11,300	11,341	11,382	270
280	11,382	11,423	11,465	11,506	11,547	11,588	11,630	11,671	11,712	11,753	11,795	280
290	11,795	11,836	11,877	11,919	11,960	12,001	12,043	12,084	12,126	12,167	12,209	290
300	12,209	12,250	12,291	12,333	12,374	12,416	12,457	12,499	12,540	12,582	12,624	300
310	12,624	12,665	12,707	12,748	12,790	12,831	12,873	12,915	12,956	12,998	13,040	310
320	13,040	13,081	13,123	13,165	13,206	13,248	13,290	13,331	13,373	13,415	13,457	320
330	13,457	13,498	13,540	13,582	13,624	13,665	13,707	13,749	13,791	13,833	13,874	330
340	13,874	13,916	13,958	14,000	14,042	14,084	14,126	14,167	14,209	14,251	14,293	340
350	14,293	14,335	14,377	14,419	14,461	14,503	14,545	14,587	14,629	14,671	14,713	350
360	14,713	14,755	14,797	14,839	14,881	14,923	14,965	15,007	15,049	15,091	15,133	360
370	15,133	15,175	15,217	15,259	15,301	15,343	15,385	15,427	15,469	15,511	15,554	370
380	15,554	15,596	15,638	15,680	15,722	15,764	15,806	15,849	15,891	15,933	15,975	380
390	15,975	16,017	16,059	16,102	16,144	16,186	16,228	16,270	16,313	16,355	16,397	390
400	16,397	16,439	16,482	16,524	16,566	16,608	16,651	16,693	16,735	16,778	16,820	400
410	16,820	16,862	16,904	16,947	16,989	17,031	17,074	17,116	17,158	17,201	17,243	410
420	17,243	17,285	17,328	17,370	17,413	17,455	17,497	17,540	17,582	17,624	17,667	420

Termoelektrické napětí - termočlánek "K"

°C	0	1	2	3	4	5	6	7	8	9	10	°C
430	17,667	17,709	17,752	17,794	17,837	17,879	17,921	17,964	18,006	18,049	18,091	430
440	18,091	18,134	18,176	18,218	18,261	18,303	18,346	18,388	18,431	18,473	18,516	440
450	18,516	18,558	18,601	18,643	18,686	18,728	18,771	18,813	18,856	18,898	18,941	450
460	18,941	18,983	19,026	19,068	19,111	19,154	19,196	19,239	19,281	19,324	19,366	460
470	19,366	19,409	19,451	19,494	19,537	19,579	19,622	19,664	19,707	19,750	19,792	470
480	19,792	19,835	19,877	19,920	19,962	20,005	20,048	20,090	20,133	20,175	20,218	480
490	20,218	20,261	20,303	20,346	20,389	20,431	20,474	20,516	20,559	20,602	20,644	490
500	20,644	20,687	20,730	20,772	20,815	20,857	20,900	20,943	20,985	21,028	21,071	500
510	21,071	21,113	21,156	21,199	21,241	21,284	21,326	21,369	21,412	21,454	21,497	510
520	21,497	21,540	21,582	21,625	21,668	21,710	21,753	21,796	21,838	21,881	21,924	520
530	21,924	21,966	22,009	22,052	22,094	22,137	22,179	22,222	22,265	22,307	22,350	530
540	22,350	22,393	22,435	22,478	22,521	22,563	22,606	22,649	22,691	22,734	22,776	540
550	22,776	22,819	22,862	22,904	22,947	22,990	23,032	23,075	23,117	23,160	23,203	550
560	23,203	23,245	23,288	23,331	23,373	23,416	23,458	23,501	23,544	23,586	23,629	560
570	23,629	23,671	23,714	23,757	23,799	23,842	23,884	23,927	23,970	24,012	24,055	570
580	24,055	24,097	24,140	24,182	24,225	24,267	24,310	24,353	24,395	24,438	24,480	580
590	24,480	24,523	24,565	24,608	24,650	24,693	24,735	24,778	24,820	24,863	24,905	590
600	24,905	24,948	24,990	25,033	25,075	25,118	25,160	25,203	25,245	25,288	25,330	600
610	25,330	25,373	25,415	25,458	25,500	25,543	25,585	25,627	25,670	25,712	25,755	610
620	25,755	25,797	25,840	25,882	25,924	25,967	26,009	26,052	26,094	26,136	26,179	620
630	26,179	26,221	26,263	26,306	26,348	26,390	26,433	26,475	26,517	26,560	26,602	630
640	26,602	26,644	26,687	26,729	26,771	26,814	26,856	26,898	26,940	26,983	27,025	640
650	27,025	27,067	27,109	27,152	27,194	27,236	27,278	27,320	27,363	27,405	27,447	650
660	27,447	27,489	27,531	27,574	27,616	27,658	27,700	27,742	27,784	27,826	27,869	660
670	27,869	27,911	27,953	27,995	28,037	28,079	28,121	28,163	28,205	28,247	28,289	670
680	28,289	28,332	28,374	28,416	28,458	28,500	28,542	28,584	28,626	28,668	28,710	680
690	28,710	28,752	28,794	28,835	28,877	28,919	28,961	29,003	29,045	29,087	29,129	690
700	29,129	29,171	29,213	29,255	29,297	29,338	29,380	29,422	29,464	29,506	29,548	700
710	29,548	29,589	29,631	29,673	29,715	29,757	29,798	29,840	29,882	29,924	29,965	710
720	29,965	30,007	30,049	30,090	30,132	30,174	30,216	30,257	30,299	30,341	30,382	720
730	30,382	30,424	30,466	30,507	30,549	30,590	30,632	30,674	30,715	30,757	30,798	730
740	30,798	30,840	30,881	30,923	30,964	31,006	31,047	31,089	31,130	31,172	31,213	740
750	31,213	31,255	31,296	31,338	31,379	31,421	31,462	31,504	31,545	31,586	31,628	750
760	31,628	31,669	31,710	31,752	31,793	31,834	31,876	31,917	31,958	32,000	32,041	760
770	32,041	32,082	32,124	32,165	32,206	32,247	32,289	32,330	32,371	32,412	32,453	770
780	32,453	32,495	32,536	32,577	32,618	32,659	32,700	32,742	32,783	32,824	32,865	780
790	32,865	32,906	32,947	32,988	33,029	33,070	33,111	33,152	33,193	33,234	33,275	790
800	33,275	33,316	33,357	33,398	33,439	33,480	33,521	33,562	33,603	33,644	33,685	800
810	33,685	33,726	33,767	33,808	33,848	33,889	33,930	33,971	34,012	34,053	34,093	810
820	34,093	34,134	34,175	34,216	34,257	34,297	34,338	34,379	34,420	34,460	34,501	820
830	34,501	34,542	34,582	34,623	34,664	34,704	34,745	34,786	34,826	34,867	34,908	830
840	34,908	34,948	34,989	35,029	35,070	35,110	35,151	35,192	35,232	35,273	35,313	840
850	35,313	35,354	35,394	35,435	35,475	35,516	35,556	35,596	35,637	35,677	35,718	850
860	35,718	35,758	35,798	35,839	35,879	35,920	35,960	36,000	36,041	36,081	36,121	860
870	36,121	36,162	36,202	36,242	36,282	36,323	36,363	36,403	36,443	36,484	36,524	870
880	36,524	36,564	36,604	36,644	36,685	36,725	36,765	36,805	36,845	36,885	36,925	880
890	36,925	36,965	37,006	37,046	37,086	37,126	37,166	37,206	37,246	37,286	37,326	890
900	37,326	37,366	37,406	37,446	37,486	37,526	37,566	37,606	37,646	37,686	37,725	900
910	37,725	37,765	37,805	37,845	37,885	37,925	37,965	38,005	38,044	38,084	38,124	910
920	38,124	38,164	38,204	38,243	38,283	38,323	38,363	38,402	38,442	38,482	38,522	920
930	38,522	38,561	38,601	38,641	38,680	38,720	38,760	38,799	38,839	38,878	38,918	930
940	38,918	38,958	38,997	39,037	39,076	39,116	39,155	39,195	39,235	39,274	39,314	940
950	39,314	39,353	39,393	39,432	39,471	39,511	39,550	39,590	39,629	39,669	39,708	950
960	39,708	39,747	39,787	39,826	39,866	39,905	39,944	39,984	40,023	40,062	40,101	960
970	40,101	40,141	40,180	40,219	40,259	40,298	40,337	40,376	40,415	40,455	40,494	970
980	40,494	40,533	40,572	40,611	40,651	40,690	40,729	40,768	40,807	40,846	40,885	980
990	40,885	40,924	40,963	41,002	41,042	41,081	41,120	41,159	41,198	41,237	41,276	990
1000	41,276	41,315	41,354	41,393	41,431	41,470	41,509	41,548	41,587	41,626	41,665	1000
1010	41,665	41,704	41,743	41,781	41,820	41,859	41,898	41,937	41,976	42,014	42,053	1010
1020	42,053	42,092	42,131	42,169	42,208	42,247	42,286	42,324	42,363	42,402	42,440	1020
1030	42,440	42,479	42,518	42,556	42,595	42,633	42,672	42,711	42,749	42,788	42,826	1030
1040	42,826	42,865	42,903	42,942	42,980	43,019	43,057	43,096	43,134	43,173	43,211	1040
1050	43,211	43,250	43,288	43,327	43,365	43,403	43,442	43,480	43,518	43,557	43,595	1050
1060	43,595	43,633	43,672	43,710	43,748	43,787	43,825	43,863	43,901	43,940	43,978	1060
1070	43,978	44,016	44,054	44,092	44,130	44,169	44,207	44,245	44,283	44,321	44,359	1070
1080	44,359	44,397	44,435	44,473	44,512	44,550	44,588	44,626	44,664	44,702	44,740	1080
1090	44,740	44,778	44,816	44,854	44,891	44,929	44,967	45,005	45,043	45,081	45,119	1090
1100	45,119	45,157	45,194	45,232	45,270	45,308	45,346	45,383	45,421	45,459	45,497	1100
1110	45,497	45,534	45,572	45,610	45,647	45,685	45,723	45,760	45,798	45,836	45,873	1110
1120	45,873	45,911	45,948	45,986	46,024	46,061	46,099	46,136	46,174	46,211	46,249	1120

Termoelektrické napětí - termočlánek "K"

°C	0	1	2	3	4	5	6	7	8	9	10	°C
1130	46,249	46,286	46,324	46,361	46,398	46,436	46,473	46,511	46,548	46,585	46,623	1130
1140	46,623	46,660	46,697	46,735	46,772	46,809	46,847	46,884	46,921	46,958	46,995	1140
1150	46,995	47,033	47,070	47,107	47,144	47,181	47,218	47,256	47,293	47,330	47,367	1150
1160	47,367	47,404	47,441	47,478	47,515	47,552	47,589	47,626	47,663	47,700	47,737	1160
1170	47,737	47,774	47,811	47,848	47,884	47,921	47,958	47,995	48,032	48,069	48,105	1170
1180	48,105	48,142	48,179	48,216	48,252	48,289	48,326	48,363	48,399	48,436	48,473	1180
1190	48,473	48,509	48,546	48,582	48,619	48,656	48,692	48,729	48,765	48,802	48,838	1190
1200	48,838	48,875	48,911	48,948	48,984	49,021	49,057	49,093	49,130	49,166	49,202	1200
1210	49,202	49,239	49,275	49,311	49,348	49,384	49,420	49,456	49,493	49,529	49,565	1210
1220	49,565	49,601	49,637	49,674	49,710	49,746	49,782	49,818	49,854	49,890	49,926	1220
1230	49,926	49,962	49,998	50,034	50,070	50,106	50,142	50,178	50,214	50,250	50,286	1230
1240	50,286	50,322	50,358	50,393	50,429	50,465	50,501	50,537	50,572	50,608	50,644	1240
1250	50,644	50,680	50,715	50,751	50,787	50,822	50,858	50,894	50,929	50,965	51,000	1250
1260	51,000	51,036	51,071	51,107	51,142	51,178	51,213	51,249	51,284	51,320	51,355	1260
1270	51,355	51,391	51,426	51,461	51,497	51,532	51,567	51,603	51,638	51,673	51,708	1270
1280	51,708	51,744	51,779	51,814	51,849	51,885	51,920	51,955	51,990	52,025	52,060	1280
1290	52,060	52,095	52,130	52,165	52,200	52,235	52,270	52,305	52,340	52,375	52,410	1290
1300	52,410	52,445	52,480	52,515	52,550	52,585	52,620	52,654	52,689	52,724	52,759	1300
1310	52,759	52,794	52,828	52,863	52,898	52,932	52,967	53,002	53,037	53,071	53,106	1310
1320	53,106	53,140	53,175	53,210	53,244	53,279	53,313	53,348	53,382	53,417	53,451	1320
1330	53,451	53,486	53,520	53,555	53,589	53,623	53,658	53,692	53,727	53,761	53,795	1330
1340	53,795	53,830	53,864	53,898	53,932	53,967	54,001	54,035	54,069	54,104	54,138	1340
1350	54,138	54,172	54,206	54,240	54,274	54,308	54,343	54,377	54,411	54,445	54,479	1350
1360	54,479	54,513	54,547	54,581	54,615	54,649	54,683	54,717	54,751	54,785	54,819	1360
1370	54,819	54,852	54,886									1370


$$U_T = \text{tab}(t_M) - \text{tab}(t_S)$$

U_T ... napětí na termočlátku [mV]

t_M ... měřená teplota [°C]

t_S ... srovnávací teplota [°C]

tab() ... hodnota v tabulce pro určitou teplotu a určitý typ termočlátku [°C]

		CHARAKTERISTIKA Čidla teploty Pt 100, Tk = 3911 ppm/ °C				Pt100/3911	
						VÝTISK ČÍSLO	
AUTOR	Lukáš Osadník					SKART. ZNAK	S10
STRANA	1 z 3	VERZE	A z 18.6.10	NAHRAZUJE		KLASIF. KÓD	I

Základní technické parametry

Snímací prvek	Tenkvrstvý platinový odpor
Maximální rozsah pracovních teplot	-200 až 400 °C *
Odpor při 0 °C	100 Ω
Dlouhodobá stabilita odporu	0,05% po 1000 hod při teplotě 400 °C
Doporučený / maximální ss měřicí proud	0,3 - 1mA / 5mA

* Skutečný rozsah pracovních teplot snímače je dán konstrukcí a technologií

Teplotní závislost odporu čidla je vyjádřena rovnicí

$$R = 100 (1 + At + Bt^2 + C (t-100) t^3)$$

$$R = 100 (1 + At + Bt^2)$$

v rozsahu teplot -200 až 0 °C

v rozsahu teplot 0 až 400 °C

kde:

$$A = 3,9692 \cdot 10^{-3} \text{ °C}^{-1}$$


$$B = -5,829 \cdot 10^{-7} \text{ °C}^{-2}$$

$$C = -4,3303 \cdot 10^{-12} \text{ °C}^{-4}$$


Závislost hodnoty odporu na teplotě

°C	0	-1	-2	-3	-4	-5	-6	-7	-8	-9
-200	17,25									
-190	21,62	21,18	20,75	20,31	19,87	19,44	19,00	18,56	18,12	17,68
-180	25,96	25,53	25,09	24,66	24,23	23,79	23,36	22,92	22,49	22,06
-170	30,26	29,84	29,41	28,98	28,55	28,12	27,68	27,25	26,82	26,39
-160	34,54	34,11	33,69	33,26	32,83	32,41	31,98	31,55	31,12	30,69
-150	38,79	38,36	37,94	37,51	37,09	36,67	36,24	35,82	35,39	34,97
-140	43,00	42,58	42,16	41,74	41,32	40,90	40,48	40,05	39,63	39,21
-130	47,20	46,78	46,36	45,94	45,52	45,10	44,68	44,26	43,84	43,42
-120	51,37	50,95	50,53	50,12	49,70	49,28	48,87	48,45	48,03	47,61
-110	55,51	55,10	54,68	54,27	53,86	53,44	53,03	52,61	52,20	51,78
-100	59,64	59,23	58,81	58,40	57,99	57,58	57,17	56,75	56,34	55,93
-90	63,75	63,34	62,93	62,52	62,10	61,69	61,28	60,87	60,46	60,05
-80	67,83	67,43	67,02	66,61	66,20	65,79	65,38	64,97	64,56	64,15
-70	71,90	71,50	71,09	70,69	70,28	69,87	69,46	69,06	68,65	68,24
-60	75,96	75,56	75,15	74,75	74,34	73,93	73,53	73,12	72,72	72,31
-50	80,00	79,60	79,19	78,79	78,39	77,98	77,58	77,17	76,77	76,36
-40	84,03	83,62	83,22	82,82	82,42	82,01	81,61	81,21	80,81	80,40
-30	88,04	87,64	87,24	86,84	86,44	86,03	85,63	85,23	84,83	84,43
-20	92,04	91,64	91,24	90,84	90,44	90,04	89,64	89,24	88,84	88,44
-10	96,02	95,63	95,23	94,83	94,43	94,03	93,63	93,24	92,84	92,44
0	100,00	99,60	99,21	98,81	98,41	98,01	97,62	97,22	96,82	96,42

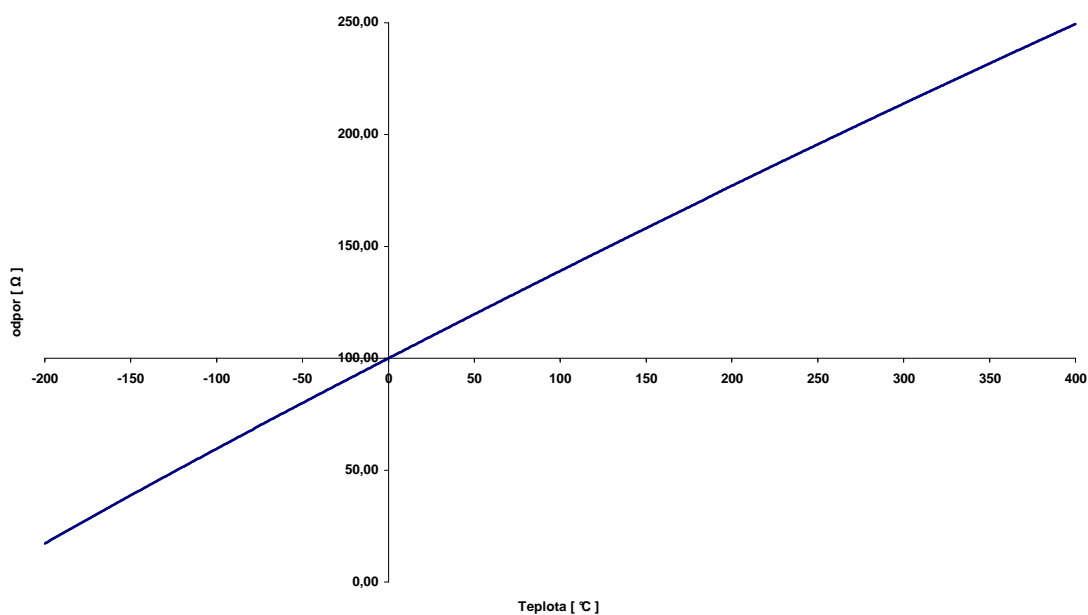
°C	0	1	2	3	4	5	6	7	8	9
0	100,00	100,40	100,79	101,19	101,59	101,98	102,38	102,78	103,17	103,57
10	103,96	104,36	104,75	105,15	105,55	105,94	106,34	106,73	107,13	107,52
20	107,92	108,31	108,70	109,10	109,49	109,89	110,28	110,67	111,07	111,46
30	111,86	112,25	112,64	113,03	113,43	113,82	114,21	114,61	115,00	115,39
40	115,78	116,18	116,57	116,96	117,35	117,74	118,13	118,53	118,92	119,31
50	119,70	120,09	120,48	120,87	121,26	121,65	122,04	122,44	122,83	123,22

		CHARAKTERISTIKA Čidla teploty Pt 100, Tk = 3911 ppm/ °C					Pt100/3911	
AUTOR	Lukáš Osadník						VÝTISK ČÍSLO	
STRANA	2 z 3	VERZE	A z 18.6.10	NAHRAZUJE		SKART. ZNAK	S10	
						KLASIF. KÓD	I	

60	123,61	124,00	124,38	124,77	125,16	125,55	125,94	126,33	126,72	127,11
70	127,50	127,89	128,28	128,66	129,05	129,44	129,83	130,22	130,61	130,99
80	131,38	131,77	132,16	132,54	132,93	133,32	133,70	134,09	134,48	134,86
90	135,25	135,64	136,02	136,41	136,80	137,18	137,57	137,95	138,34	138,72
100	139,11	139,49	139,88	140,26	140,65	141,03	141,42	141,80	142,19	142,57
110	142,96	143,34	143,72	144,11	144,49	144,87	145,26	145,64	146,02	146,41
120	146,79	147,17	147,56	147,94	148,32	148,70	149,09	149,47	149,85	150,23
130	150,61	151,00	151,38	151,76	152,14	152,52	152,90	153,28	153,66	154,05
140	154,43	154,81	155,19	155,57	155,95	156,33	156,71	157,09	157,47	157,85
150	158,23	158,61	158,99	159,36	159,74	160,12	160,50	160,88	161,26	161,64
160	162,01	162,39	162,77	163,15	163,53	163,90	164,28	164,66	165,04	165,41
170	165,79	166,17	166,55	166,92	167,30	167,68	168,05	168,43	168,80	169,18
180	169,56	169,93	170,31	170,68	171,06	171,44	171,81	172,19	172,56	172,94
190	173,31	173,69	174,06	174,43	174,81	175,18	175,56	175,93	176,30	176,68
200	177,05	177,43	177,80	178,17	178,55	178,92	179,29	179,66	180,04	180,41
210	180,78	181,15	181,53	181,90	182,27	182,64	183,02	183,39	183,76	184,13
220	184,50	184,87	185,24	185,61	185,99	186,36	186,73	187,10	187,47	187,84
230	188,21	188,58	188,95	189,32	189,69	190,06	190,43	190,80	191,17	191,53
240	191,90	192,27	192,64	193,01	193,38	193,75	194,11	194,48	194,85	195,22
250	195,59	195,95	196,32	196,69	197,06	197,42	197,79	198,16	198,53	198,89
260	199,26	199,63	199,99	200,36	200,72	201,09	201,46	201,82	202,19	202,55
270	202,92	203,28	203,65	204,01	204,38	204,74	205,11	205,47	205,84	206,20
280	206,57	206,93	207,30	207,66	208,02	208,39	208,75	209,11	209,48	209,84
290	210,20	210,57	210,93	211,29	211,66	212,02	212,38	212,74	213,11	213,47
300	213,83	214,19	214,55	214,92	215,28	215,64	216,00	216,36	216,72	217,08
310	217,44	217,80	218,16	218,53	218,89	219,25	219,61	219,97	220,33	220,69
320	221,05	221,41	221,76	222,12	222,48	222,84	223,20	223,56	223,92	224,28
330	224,64	224,99	225,35	225,71	226,07	226,43	226,78	227,14	227,50	227,86
340	228,21	228,57	228,93	229,29	229,64	230,00	230,36	230,71	231,07	231,43
350	231,78	232,14	232,49	232,85	233,21	233,56	233,92	234,27	234,63	234,98
360	235,34	235,69	236,05	236,40	236,76	237,11	237,46	237,82	238,17	238,53
370	238,88	239,23	239,59	239,94	240,29	240,65	241,00	241,35	241,71	242,06
380	242,41	242,77	243,12	243,47	243,82	244,17	244,53	244,88	245,23	245,58
390	245,93	246,28	246,64	246,99	247,34	247,69	248,04	248,39	248,74	249,09
400	249,44									

		CHARAKTERISTIKA Čidla teploty Pt 100, Tk = 3911 ppm/ °C				Pt100/3911			
						VÝTISK ČÍSLO			
AUTOR	Lukáš Osadník	VERZE		A z 18.6.10		NAHRAZUJE		SKART. ZNAK	S10
STRANA	3 z 3							KLASIF. KÓD	I

Charakteristika čidla



Třídy přesnosti čidla

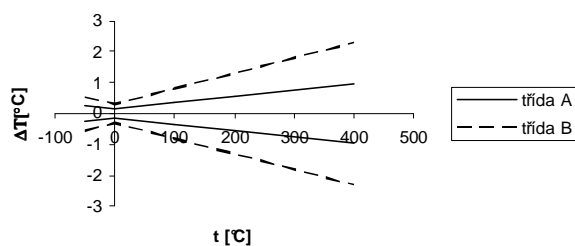
Čidla jsou vyráběna ve dvou základních třídách přesnosti, vyjádřenými těmito vztahy:


Třída A	$\Delta T = \pm (0,15 + 0,002 * t)$ ve °C
Třída B	$\Delta T = \pm (0,30 + 0,005 * t)$ ve °C

* $|t|$ je absolutní hodnota teploty

Teplota [°C]	Odpor [Ω]	Třída A		Třída B	
		ΔT [°C]	ΔR [Ω]	ΔT [°C]	ΔR [Ω]
-50	80,00	$\pm 0,25$	$\pm 0,10$	$\pm 0,55$	$\pm 0,22$
0	100,00	$\pm 0,15$	$\pm 0,06$	$\pm 0,30$	$\pm 0,12$
100	139,11	$\pm 0,35$	$\pm 0,13$	$\pm 0,80$	$\pm 0,30$
200	177,05	$\pm 0,55$	$\pm 0,20$	$\pm 1,30$	$\pm 0,47$
400	249,44	$\pm 0,95$	$\pm 0,33$	$\pm 2,30$	$\pm 0,79$

Toleranční pole



		CHARAKTERISTIKA Čidla teploty Pt 1000, Tk = 3850 ppm/ °C				Pt1000/3850	
						VÝTISK ČÍSLO	
AUTOR	Petr Brzezina					SKART. ZNAK	S10
STRANA	1 z 2	VERZE	A z 7.1.08	NAHAZUJE		KLASIF. KÓD	I

Základní technické parametry

Snímací prvek	Tenkvrstvý platinový odpor
Maximální rozsah pracovních teplot	-50 až 400 °C *
Odpor při 0 °C	1000 Ω
Dlouhodobá stabilita odporu	0,03% po 1000 hod při teplotě 400 °C
Doporučený / maximální ss měřící proud	0,3mA / 1mA

* Skutečný rozsah pracovních teplot snímače je dán konstrukcí a technologií

Teplotní závislost odporu čidla je vyjádřena rovnicí

$$R = 1000 (1 + At + Bt^2 + C (t-100) t^3)$$

$$R = 1000 (1 + At + Bt^2)$$

v rozsahu teplot -50 až 0 °C

v rozsahu teplot 0 až 400 °C

kde:

$$A = 3,9083 \cdot 10^{-3} \text{ °C}^{-1}$$


$$B = -5,775 \cdot 10^{-7} \text{ °C}^{-2}$$

$$C = -4,183 \cdot 10^{-12} \text{ °C}^{-4}$$

Závislost hodnoty odporu na teplotě

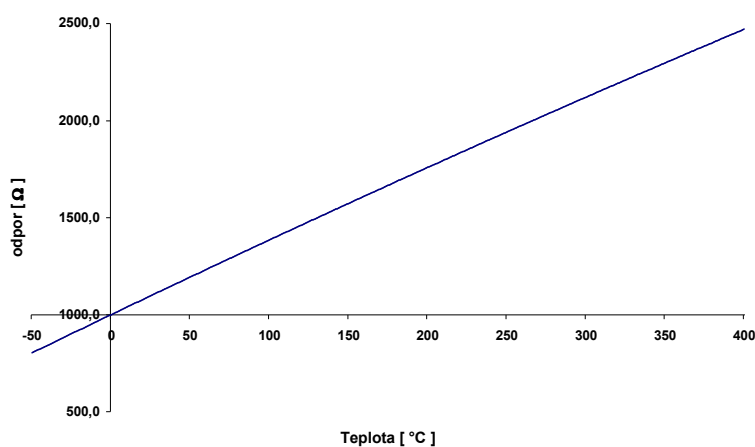
°C	0	-1	-2	-3	-4	-5	-6	-7	-8	-9
-50	803,06									
-40	842,71	838,75	834,79	830,83	826,87	822,90	818,94	814,97	811,00	807,03
-30	882,22	878,27	874,32	870,38	866,43	862,48	858,53	854,57	850,62	846,66
-20	921,60	917,67	913,73	909,80	905,86	901,92	897,98	894,04	890,10	886,16
-10	960,86	956,94	953,02	949,09	945,17	941,24	937,32	933,39	929,46	925,53
0	1000,00	996,09	992,18	988,27	984,36	980,44	976,53	972,61	968,70	964,78

°C	0	1	2	3	4	5	6	7	8	9
0	1000,00	1003,91	1007,81	1011,72	1015,62	1019,53	1023,43	1027,33	1031,23	1035,13
10	1039,03	1042,92	1046,82	1050,71	1054,60	1058,49	1062,38	1066,27	1070,16	1074,05
20	1077,94	1081,82	1085,70	1089,59	1093,47	1097,35	1101,23	1105,10	1108,98	1112,86
30	1116,73	1120,60	1124,47	1128,35	1132,21	1136,08	1139,95	1143,82	1147,68	1151,55
40	1155,41	1159,27	1163,13	1166,99	1170,85	1174,70	1178,56	1182,41	1186,27	1190,12
50	1193,97	1197,82	1201,67	1205,52	1209,36	1213,21	1217,05	1220,90	1224,74	1228,58
60	1232,42	1236,26	1240,09	1243,93	1247,77	1251,60	1255,43	1259,26	1263,09	1266,92
70	1270,75	1274,58	1278,40	1282,23	1286,05	1289,87	1293,70	1297,52	1301,33	1305,15
80	1308,97	1312,78	1316,60	1320,41	1324,22	1328,03	1331,84	1335,65	1339,46	1343,26
90	1347,07	1350,87	1354,68	1358,48	1362,28	1366,08	1369,87	1373,67	1377,47	1381,26
100	1385,06	1388,85	1392,64	1396,43	1400,22	1404,00	1407,79	1411,58	1415,36	1419,14
110	1422,93	1426,71	1430,49	1434,26	1438,04	1441,82	1445,59	1449,37	1453,14	1456,91
120	1460,68	1464,45	1468,22	1471,98	1475,75	1479,51	1483,28	1487,04	1490,80	1494,56
130	1498,32	1502,08	1505,83	1509,59	1513,34	1517,10	1520,85	1524,60	1528,35	1532,10
140	1535,84	1539,59	1543,33	1547,08	1550,82	1554,56	1558,30	1562,04	1565,78	1569,52
150	1573,25	1576,99	1580,72	1584,45	1588,18	1591,91	1595,64	1599,37	1603,09	1606,82
160	1610,54	1614,27	1617,99	1621,71	1625,43	1629,15	1632,86	1636,58	1640,30	1644,01
170	1647,72	1651,43	1655,14	1658,85	1662,56	1666,27	1669,97	1673,68	1677,38	1681,08
180	1684,78	1688,48	1692,18	1695,88	1699,58	1703,27	1706,96	1710,66	1714,35	1718,04
190	1721,73	1725,42	1729,10	1732,79	1736,48	1740,16	1743,84	1747,52	1751,20	1754,88
200	1758,56	1762,24	1765,91	1769,59	1773,26	1776,93	1780,60	1784,27	1787,94	1791,61
210	1795,28	1798,94	1802,60	1806,27	1809,93	1813,59	1817,25	1820,91	1824,56	1828,22
220	1831,88	1835,53	1839,18	1842,83	1846,48	1850,13	1853,78	1857,43	1861,07	1864,72
230	1868,36	1872,00	1875,64	1879,28	1882,92	1886,56	1890,19	1893,83	1897,46	1901,10
240	1904,73	1908,36	1911,99	1915,62	1919,24	1922,87	1926,49	1930,12	1933,74	1937,36
250	1940,98	1944,60	1948,22	1951,83	1955,45	1959,06	1962,68	1966,29	1969,90	1973,51
260	1977,12	1980,73	1984,33	1987,94	1991,54	1995,14	1998,75	2002,35	2005,95	2009,54
270	2013,14	2016,74	2020,33	2023,93	2027,52	2031,11	2034,70	2038,29	2041,88	2045,46
280	2049,05	2052,63	2056,22	2059,80	2063,38	2066,96	2070,54	2074,11	2077,69	2081,27

		CHARAKTERISTIKA Čidla teploty Pt 1000, Tk = 3850 ppm/ °C				Pt1000/3850	
						VÝTISK ČÍSLO	
AUTOR	Petr Brzezina					SKART. ZNAK	S10
STRANA	2 z 2	VERZE	A z 7.1.08	NAHAZUJE		KLASIF. KÓD	I

290	2084,84	2088,41	2091,98	2095,55	2099,12	2102,69	2106,26	2109,82	2113,39	2116,95
300	2120,52	2124,08	2127,64	2131,20	2134,75	2138,31	2141,87	2145,42	2148,97	2152,52
310	2156,08	2159,62	2163,17	2166,72	2170,27	2173,81	2177,36	2180,90	2184,44	2187,98
320	2191,52	2195,06	2198,60	2202,13	2205,67	2209,20	2212,73	2216,26	2219,79	2223,32
330	2226,85	2230,38	2233,90	2237,43	2240,95	2244,47	2247,99	2251,51	2255,03	2258,55
340	2262,06	2265,58	2269,09	2272,60	2276,12	2279,63	2283,14	2286,64	2290,15	2293,66
350	2297,16	2300,66	2304,17	2307,67	2311,17	2314,67	2318,16	2321,66	2325,16	2328,65
360	2332,14	2335,64	2339,13	2342,62	2346,10	2349,59	2353,08	2356,56	2360,05	2363,53
370	2367,01	2370,49	2373,97	2377,45	2380,93	2384,40	2387,88	2391,35	2394,82	2398,29
380	2401,76	2405,23	2408,70	2412,17	2415,63	2419,10	2422,56	2426,02	2429,48	2432,94
390	2436,40	2439,86	2443,31	2446,77	2450,22	2453,67	2457,13	2460,58	2464,03	2467,47
400	2470,92									

Charakteristika čidla



Třídy přesnosti čidla

Čidla jsou vyráběna ve dvou základních třídách přesnosti, vyjádřenými těmito vztahy:

Třída A	$\Delta T = \pm (0,15 + 0,002 * t)$ ve °C
Třída B	$\Delta T = \pm (0,30 + 0,005 * t)$ ve °C

* |t| je absolutní hodnota teploty

Teplota [°C]	Odpor [Ω]	Třída A		Třída B	
		ΔT [°C]	ΔR [Ω]	ΔT [°C]	ΔR [Ω]
-50	803,06	± 0,25	± 0,99	± 0,55	± 2,18
0	1000,0	± 0,15	± 0,59	± 0,30	± 1,17
100	1385,06	± 0,35	± 1,33	± 0,80	± 3,03
200	1758,56	± 0,55	± 2,02	± 1,30	± 4,78
400	2470,92	± 0,95	± 3,27	± 2,30	± 7,94

Toleranční pole

