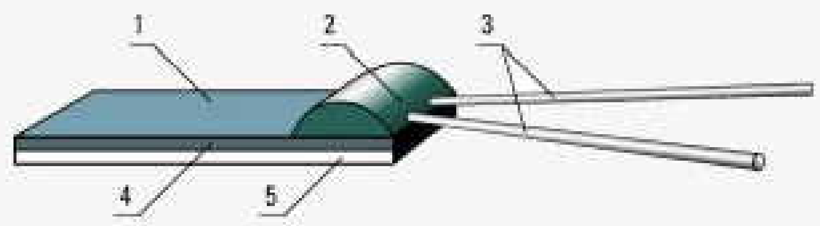
Platinum Temperature Sensors

Platinum temperature sensors

Platinum temperature sensor elements are part of our long established product range, with successful application over many years. Produced in thin film process, they can form part of temperature sensor modules of our own design and production, or could be supplied for temperature measuring applications in areas including:

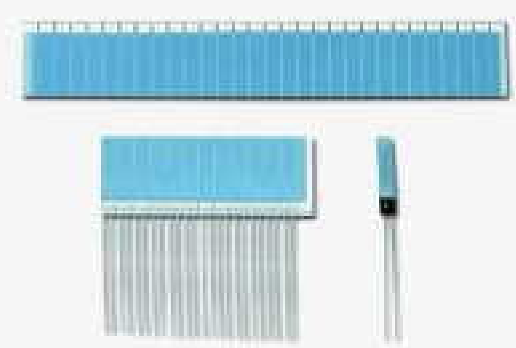


construction of Pt-temperature sensors:
1 passivating layer
2 locking layer
3 connection wires
4 structured platinum layer
5 Al_2O_3-carrier substrate

- industrial equipment
- medical applications
- transport and automotive industry
- agricultural applications
- energy and environmental applications

Our temperature sensor elements are also used successfully as components in resistance thermometers. The construction process of the elements ensures a high degree of reliability in many applications. Even in very small sizes short response times and long term stability are maintained. Our volume production permits us to offer clients very competitive prices. Special shapes and dimensions to customer requirements can be developed and produced with short lead times. The temperature sensor elements produced are thin film sensors on which the temperature dependant resistant has been applied in form of a thin, laserstructured platinum layer on a Al_2O_3 carrier substrate.

The platinum layer has been protected with a glass-/ceramics-passivating coat against chemical and mechanical effects. The elements are shock proof and can be used in extreme environments. Suitable types are available for many varying areas of application.



These may differ in respect of:

- measuring range
- nominal resistance from 10 to 2000 Ohm at 0 °C
- the geometric dimensions from 0.4 mm
- shape

Basic values from -200 °C to +600 °C (acc. to EN 60751):

- **table 1:** Basic values
- Mean temperature coefficient between 0 °C and +100 °C: $3{,}85 \times 10^{-3}\ K^{-1}$

The basic values for Pt temperature sensors can be calculated using the following formulae:

- For range -200 °C to 0 °C use:

$$R_t = R_0\,(1 + At + Bt^2 + C\,(t - 100\ °C)\,t^3)$$

- For range 0 °C to +850 °C use:

$$R_t = R_0\,(1 + At + Bt^2)$$

- whereby:

R_t resistance in Ohm at temperature t	$A = 3{,}9083 \times 10^{-3}\ °C^{-1}$
R_0 nominal resistance at 0 °C	$B = -5{,}775 \times 10^{-7}\ °C^{-2}$
t temperature in °C	$C = -4{,}183 \times 10^{-12}\ °C^{-4}$

- All Pt temperature sensors referred to will be supplied to class B tolerances as standard:

$$\Delta t \text{ in } °C = \pm\,(0{,}3 + 0{,}005[t])$$

- For applications with requirements for exceptionally close tolerances, temperature sensor elements to class A or better can be offered and supplied against extra costs.

$$\Delta t \text{ in } °C = \pm\,(0{,}15 + 0{,}002[t])$$

In many applications the following tighter tolerances have proved to be especially suitable. They can be supplied at extra cost and against special order:

± 0,15 °C at 0 °C and ± 0,1 °C at 0 °C

Upon request and as special option we can also supply sensor elements where the constant of A and B would be measured at three points.
For measuring requirements with lesser accuracy we can supply sensor elements with wider tolerances at very attractive prices:

± 0,45 °C at 0 °C and ± 1,5 °C at 0 °C

Tolerance in °C are applicable for all nominal resistance values, whilst those in Ohm are only applicable for Pt 100. For other resistance values the tolerances in Ohm have to be multiplied with a factor $R_0/100$.

- **Table 2:** permitted tolerances
- **Table 3:** basic values for Pt 100 from -200 °C ... 0 °C
- **Table 4:** basic values for Pt 100 from 0 °C ... +850 °C

Platinum Temperature Sensors

Self heating

As is normal with any body charged with current, temperature sensor elements heat up slightly in use. This is described as heating up error and is dependent on:

- the power of the electric charge ($P = I^2 \times R$)
- the dissipating heat
- the operative constant EK (self heating coefficient)

Self heating can be calculated using the following formulae:

$\Delta t = P/EK$ whereby: Δt = self heating in K
P = the power applied to the measuring element in mW
EK = self heating coefficient in mW/K

Response times and self heating coefficients can be taken from table upply Data? For quick reference relating to self heating, the table shows for every sensor type the current in mA which is producing a self heating effect of 0.1 K in running water and moving air.

Response times

Pt-thin film sensor elements have a very short response time. These are dependent on the temperature sensor and, in particular, the ambient conditions. To ensure better dynamics it is advisable to avoid air pockets when installing the elements in equipment.

Long term stability

When compared with other types of temperature sensors, platinum sensors posses a greater long term stability, especially in higher temperature ranges, e.g. type FMS 2000 display a change in resistance of < 0.02 % after 1000 hours at +400 蚓.

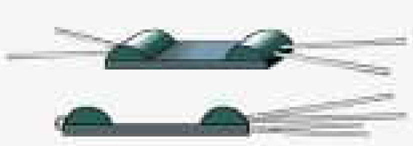
Delivery programme

The most commonly used standard types are shown in graphs. These can usually be supplied with short lead times and at competitive prices. For unusual applications special types can be supplied, these can vary in respect of:

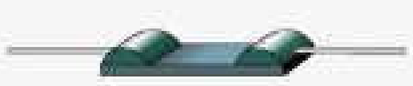
sensor element in standard form

sensor element with 4 connecting wires

sensor element with thin wires on both sides

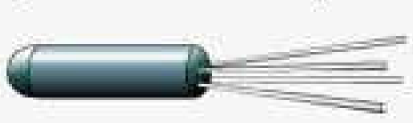


sensor element with single wire on either end



sensor element with protective sleeve

sensor element in ceramic case (with twin or more wires)



- different dimensions
- different temperature coefficients
- different tolerances
- different nominal resistance
- different length of connecting wires
- sensor elements with 3 or 4 connecting wires

Sensor elements ?special manufacture

Advantages of 4 connecting wires:

- definite measuring results through discontinue of the wire resistance and thermal decoupling between sensor and surrounding medium, because very thin wires could be used (< 0.07 mm)
- length of connecting cables does not influence the result

Delivery types (customer specific production):

- as chip
- in ceramic or stainless steel case
- with connecting wires and connector

The size of the chip, the dimensions and the types of connecting wires and cable designed to special application.

E.g.:
Measuring elements with wires on both sides, in the following sizes:

- 1 x 5 mm
- 0,8 x 10 mm
- 0,6 x 4 mm

Measuring elements with wires on one side only, in the following sizes:

- 1 x 5 mm
- 1,15 x 5 mm
- 1 x 10 mm

Upon enquiry we can also supply other types. In line with our standard types, also these can be supplied with AgPds wires for temperatures to +400 °C or with pt wire for applications to +600 °C. However, the diameter of the wires is dependent on the relevant chip dimensions.

High temperature sensors

Special types with special characteristic curves, e.g. middle TK $3{,}5 \times 10^{-3}\ K^{-1}$ for application at +750 蚓, basic values between 0 °C and +750 °C:

$R_t = R_0 (1 + At + Bt^2)$ whereby $A = 3{,}549837 \times 10^{-3}\ °C^{-1}$
$B = -5{,}29039 \times 10^{-7}\ °C^{-2}$

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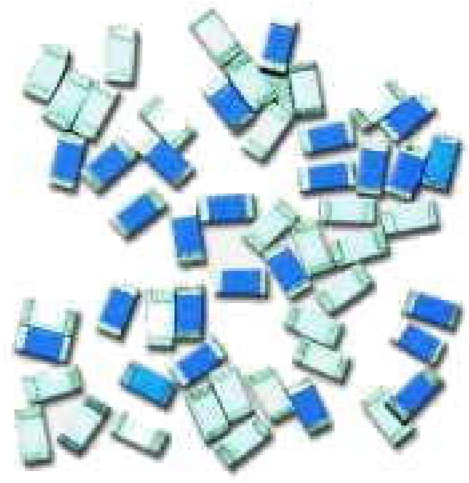
Platinum temperature sensor elements Pt 100 and Pt 1000 in SMD construction



Platinum temperature sensor elements in chip construction have a number of positive benefits, such as

- very short response time
- high long term stability
- rectangular shape for easy assembly
- wrap around contact

Technical data

Temperature range in application: -50 °C ... +150 °C
Construction: 1206/1210
R_0 at 0 °C: 100 Ohm resp. 1000 Ohm

mean TK: 3,85 x 10^{-3} K^{-1}

Range 0 °C ... +100 °C:

Tolerance class A t in °C = ± (0,15 + 0,002[t])
Tolerance class B t in °C = ± (0,30 + 0,005[t])

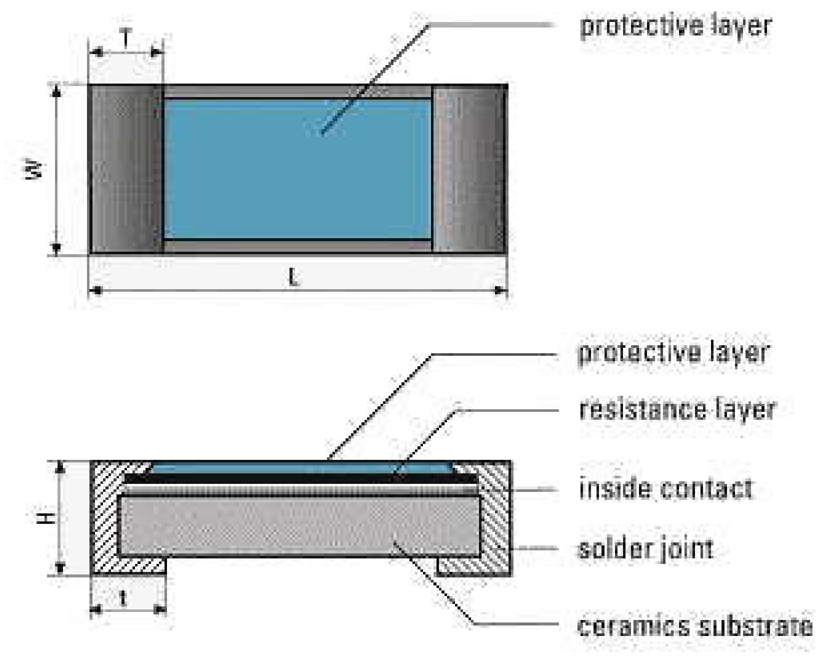
Basic values of: - 50 °C ... 0 °C

$$R_t = R_0 (1 + At + Bt^2 + C (t - 100\,°C)\, t^3)$$

Basic values of: 0 °C ... ±150 °C

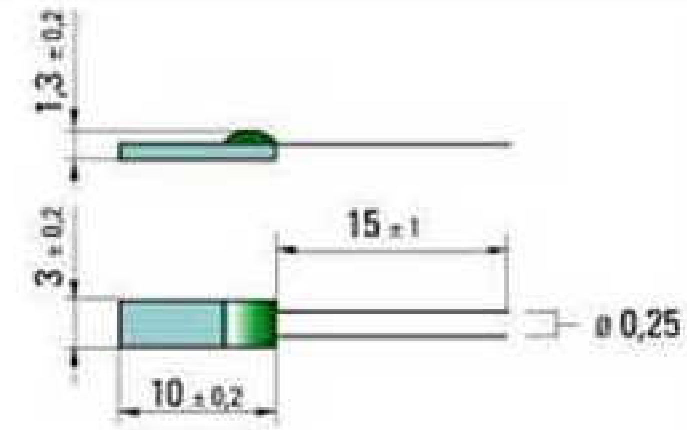
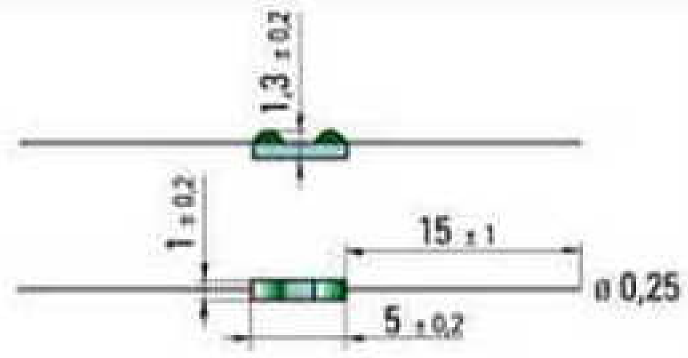
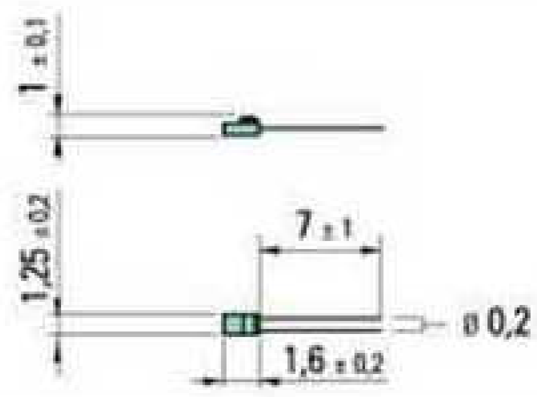
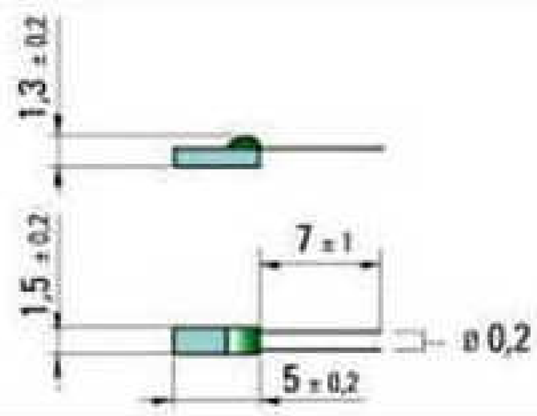
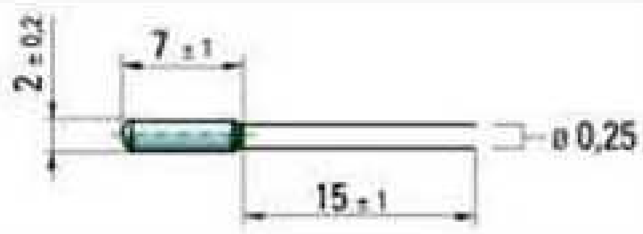
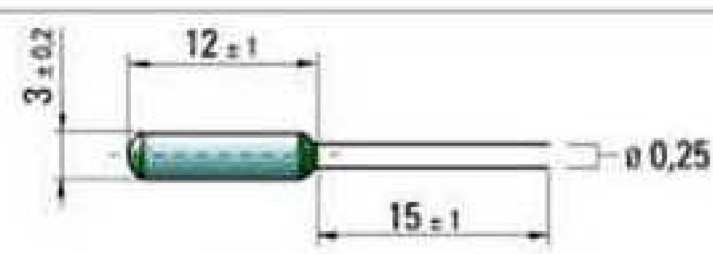
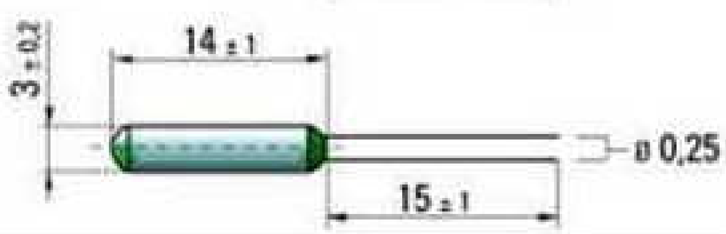
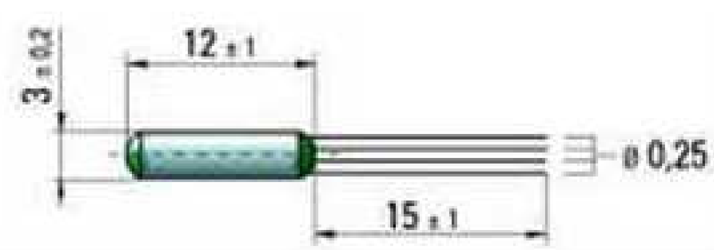
$$R_t = R_0 (1 + At + Bt^2)$$

Construction of CPT 100/CPT 1000-Chips



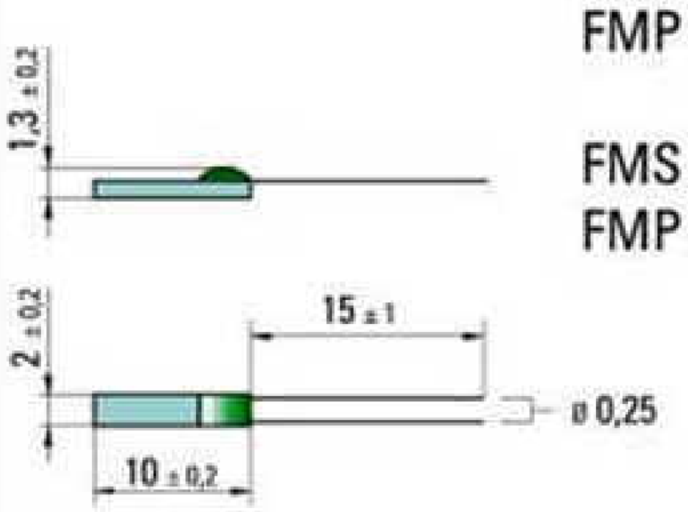
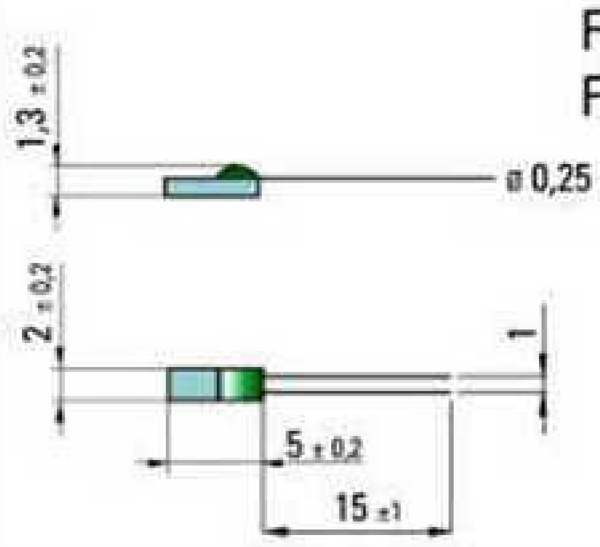
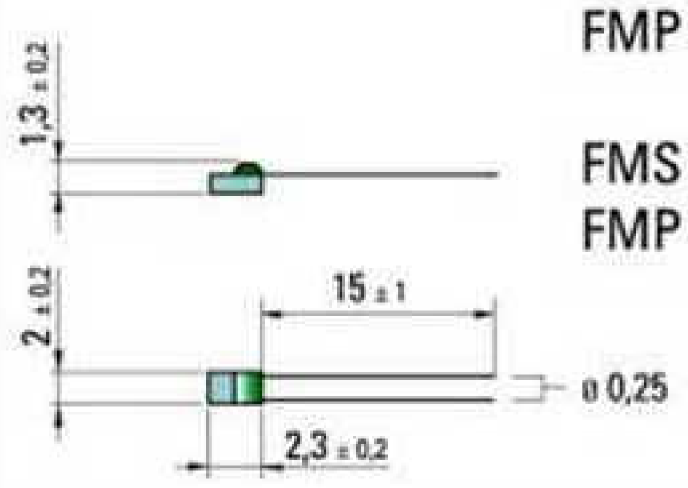
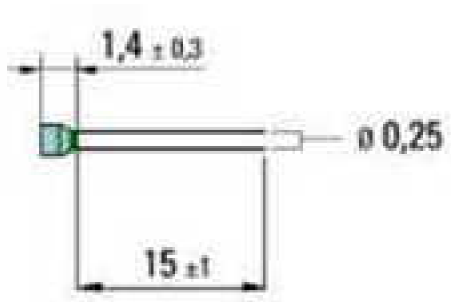
Data Chart for Platinum Temperature Sensors,forms of supply

(1/5 DIN , 1/3 DIN)

type	nominal resistance	Response time in sec.				self heating				
		water v = 0,2 m/s		air v =1 m/s		coefficient mW/K		measuring current Δt = 0,1 K bei/at 20 °C		
	Ohm	T 0,5	T 0,9	T 0,5	T 0,9	water v= 0,2 m/s	air v=1 m/s	water v =1 m/s	air v =1 m/s	
FMS 2100 FMP 2100	Pt 100	0,07	0,4	8	30	130	8	10	2	
FMS 2104 FMP 2104	Pt 100	0,05	0,2	4	10	40	4	6	2	
FMP 2108	Pt 100	0,05	0,2	3	10	40	4	6	2	
FMP 2107	Pt 100	0,07	0,4	6	10	40	8	10	2	
FMS 2103 R	Pt 100	0,07	0,3	6	20	40	6	6	2	
FMS 2132 R	Pt 500	1,3	5,0	15	50	40	10	3	1	
FMS 2142 R	Pt 1000	1,3	5,0	15	50	40	10	2	1	
FMS 2102	Pt 100	1,3	5,0	15	50	40	10	6	3	
FMS 2202 R	2 x Pt 100	1,3	5,0	15	50	40	10	6	3	

Data Chart for Platinum Temperature Sensors,forms of supply

(1/5 DIN , 1/3 DIN)

	Type	nominal resistance	response time in sec.				self heating			
			water		air		coefficient mW/K		measuring current Δt = 0,1 K bei/at 20 °C	
			v = 0,2 m/s		v =1 m/s		water	air	water	air
		Ohm	T 0,5	T 0,9	T 0,5	T 0,9	v= 0,2 m/s	v=1 m/s	v =1 m/s	v =1 m/s
	FMS 2101 FMP 2101	Pt 100	0,07	0,3	6	20	110	6	10	2
	FMS 2131 FMP 2131	Pt 500	0,07	0,3	6	20	110	6	4	1,1
	FMS 2141 FMP 2141	Pt 1000	0,07	0,3	6	20	35	6	3	0,8
	FMS 2103 FMP 2103	Pt 100	0,07	0,3	6	20	35	6	6	2
	FMS 2133 FMP 2133	Pt 500	0,07	0,3	6	20	35	6	3	1
	FMS 2105 FMP 2105	Pt 100	0,07	0,2	4	10	35	3,5	6	2
	FMS 2145 FMP 2145	Pt 1000	0,07	0,2	4	10	35	6	4	0,8
	FMA 2105	Pt 100	0,07	0,2	4	10	35	3,5	6	2

Thermal Developments International produce a wide range of Detectors using wire conforming to IEC 751 - 1995

All dimensions in mm **(1/10 DIN)**
Detectors shown same size

Detector	Resistance tolerance at 0°C	Ceramic length (mm)	Ceramic diameter (mm)	Sensing length (mm)
P100/7040	0.1%	70 + 0 / - 0.5	4 + 0 / - 0.03	65 ± 1
P100/6548	0.1%	65 + 0 / - 0.5	4.75 + 0 / - 0.03	62 ± 1
P100/5024 P2100/5024	0.1%	50 + 0 / - 0	2.4 + 0 / - 0.03	47 ± 1
P100/5015 P2100/5015	0.1%	50 + 0 / - 0.5	1.5 + 0 / - 0.03	47 ± 1
P100/3045 P2100/3045	0.1%	30 + 0 / - 0.5	4.5 + 0 / - 0.03	27 ± 1
P100/3038 P2100/3038	0.1%	30 + 0 / - 0.5	3.8 + 0 / - 0.03	27 ± 1
P100/2532 P2100/2532	0.1%	25 + 0 / - 0.5	3.2 + 0 / - 0.03	22 ± 1
P100/2528 P2100/2528	0.1%	25 + 0 / - 0.5	2.8 + 0 / - 0.03	22 ± 1
P100/2524 P2100/2524	0.1%	25 + 0 / - 0.5	2.4 + 0 / - 0.03	22 ± 1
P100/2516 P2100/2516	0.1%	25 + 0 / - 0.5	1.6 + 0 / - 0.03	22 ± 1
P100/2515 P2100/2515	0.1%	25 + 0 / - 0.5	1.5 + 0 / - 0.03	22 ± 1
P100/2020 P2100/2020	0.1%	20 + 0 / - 0.5	2.0 + 0 / - 0.03	17 ± 1
P100/1545 P2100/1545	0.1%	15 + 0 / - 0.5	4.5 + 0 / - 0.03	12 ± 1
P100/1532 P2100/1532	0.1%	15 + 0 / - 0.5	3.2 + 0 / - 0.03	12 ± 1
P100/1530 P2100/1530	0.1%	15 + 0 / - 0.5	3.0 + 0 / - 0.03	12 ± 1
P100/1528 P2100/1528	0.1%	15 + 0 / - 0.5	2.8 + 0 / - 0.03	12 ± 1
P100/1524 P2100/1524	0.1%	15 + 0 / - 0.5	2.4 + 0 / - 0.03	12 ± 1
P100/1520 P2100/1520	0.1%	15 + 0 / - 0.5	2.0 + 0 / - 0.03	12 ± 1
P100/1516 P2100/1516	0.1%	15 + 0 / - 0.5	1.6 + 0 / - 0.03	12 ± 1
P100/1516/16 Square	0.1%	15 + 0 / - 0.5	1.6 ± 0/-5% X 1.6 ± 0/-5%	12 ± 1
P100/1515 P2100/1515	0.1%	15 + 0 / - 0.5	1.5 + 0 / - 0.03	12 ± 1
P100/1512	0.1%	15 + 0 / - 0.5	1.2 ± 0 / - 0.03	12 ± 1
P100/1509	0.1%	15 + 0 / - 0.5	0.9 ± 5%	12 ± 1
P100/1508	0.1%	15 + 0 / - 0.5	0.8 + 0 / - 0.1	12 ± 1
P100/1016	0.1%	10 + 0 / - 0.5	1.6 + 0 / - 0.03	8 ± 1