

# Self-operated Temperature Regulators

## Type 9 Temperature Regulator

With balanced three-way valve <sup>1)</sup> · Flanged connections



### ANSI version

### Application

Temperature regulators with mixing or diverting valve designed for plants that are heated or cooled using liquids  
Control thermostats for set points from **15 to 480 °F** (–10 to +250 °C) · Three-way valves in valve sizes **NPS ½ to 6** (DN 15 to 150) · Pressure rating **Class 150 and 300** · Temperatures up to **660 °F** (350 °C)

### Note

Typetested temperature regulators (TR), temperature limiters (TL), safety temperature monitors (STM), and safety temperature limiters (STL) are available.



The regulators consist of a three-way valve and a control thermostat with temperature sensor, set point adjuster with excess temperature protection, capillary tube and operating element.

### Special features

- Low-maintenance proportional regulators requiring no auxiliary energy
- Wide set point range and convenient set point adjustment
- Three-way valve with plug balanced <sup>1)</sup> by a stainless steel bellows, optionally available with a plug arrangement to mix or divert liquids
- Flow rate across the port AB almost independent of the valve plug position
- Valve body optionally made of cast steel or cast stainless steel
- Versions with double adapter and manual adjuster for temperature limiters or attachment of a second control thermostat. See ▶ T 2036 for details.

### Versions

#### Type 9 Temperature Regulator with three-way valve

Type 2119 Valve NPS ½ to 1: unbalanced · NPS 1½ to 6: balanced · Class 150 and 300 · Type 2231 to 2235 Control Thermostat

Three-way valves with optional plug arrangements for either mixing or diverting service.

Further details on the application of thermostats can be found in Information Sheet ▶ T 2010.

**Type 2119/2231** (Fig. 1) · With Type 2119 Valve and Type 2231 Control Thermostat · Suitable for liquids · Set points from 15 to 300 °F (–10 to +150 °C) · Set point adjustment at the sensor

**Type 2119/2232** (Fig. 2) · With Type 2119 Valve and Type 2232 Control Thermostat · Suitable for liquids and steam  
Set points from 15 to 480 °F (–10 to +250 °C) · Separate set point adjustment

**Type 2119/2233** · With Type 2119 Valve and Type 2233 Control Thermostat · Suitable for liquids, air and other gases  
Set points from 15 to 300 °F (–10 to +150 °C) · Set point adjustment at the sensor

<sup>1)</sup> NPS ½ to 1: not balanced



Fig. 1: Type 9 Temperature Regulator with Type 2231 Control Thermostat

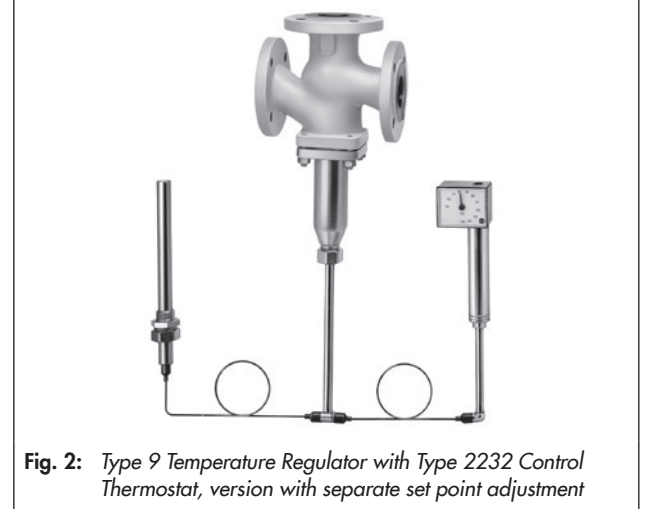


Fig. 2: Type 9 Temperature Regulator with Type 2232 Control Thermostat, version with separate set point adjustment

**Type 2119/2234** · With Type 2119 Valve and Type 2234 Control Thermostat · Suitable for liquids, air and other gases  
Set points from 15 to 480 °F (–10 to +250 °C) · Separate set point adjustment

**Type 2119/2235** · With Type 2119 Valve and Type 2235 Control Thermostat · Installation in air-heated storerooms as well as drying, climatic and heating cabinets · Set points from 15 to 480 °F (–10 to +250 °C) · Separate set point adjustment and a sensor tube to be installed on site

### Special version

- Capillary tube 15, 33 or 50 ft (5, 10 or 15 m)
- Capillary tube made of CrNiMo steel or plastic-coated copper
- Sensor of CrNiMo steel
- Valve entirely of stainless steel (at least made of 1.4301)

### Principle of operation (see Fig. 3 and Fig. 4)

The regulators operate according to the liquid expansion principle. The temperature sensor (11), capillary tube (8) and operating element (7) are filled with an expansion liquid. The temperature-dependent change in volume of this liquid causes the operating element to move and, as a result, also moves the plug stem (5) with the attached plug (3).

The position of the plug determines the flow rate of the heat transfer medium across the area released between the seat (2) and plug (3). The temperature set point is adjustable with a key (9) to a value which can be read off from the dial (10).

In the balanced valves (NPS 1½ to 6), the pressure at port B acts through a hole in the plug stem (5) onto the outer surface of the balancing bellows<sup>1)</sup> (4.1), whereas the pressure at port A acts onto the inner bellows area. This equalizes the forces acting onto the valve plugs (3).

In mixing valves (see Fig. 3 with plug arrangement I), the process media to be mixed enter at valve ports A and B. The combined flow exits the valve at port AB. The flow rate from A or B to AB is determined by the area released between the seats (2) and plugs (3), i.e. by the position of the plug stem (5). When the temperature rises, port A opens and port B closes.

In diverting valves, in contrast, the process medium enters at the valve port AB and the partial flows exit at ports A or B. The flow rate from AB to A or B is determined by the position of the plug stem. Diverting valves have the plug arrangement II (see Fig. 4). When the temperature rises, port A closes and port B opens.

<sup>1)</sup> Valves in NPS ½ to 1 have unbalanced plugs

### Installation

#### Valve

The thermostat connection (6) must face downwards. Other mounting positions on request.

Make sure the direction of flow complies with the required service type, i.e. mixing or diverting service.

#### Capillary tube

The capillary tube must be run in such a way that the ambient temperature range cannot be exceeded, any deviations in temperature cannot occur and that the tube cannot be damaged. The smallest permissible bending radius is 2" (50 mm).

#### Temperature sensor

The temperature sensor may be installed in any position. Its entire length must be immersed in the medium. It must be installed in a location where overheating or considerable idling times cannot occur.

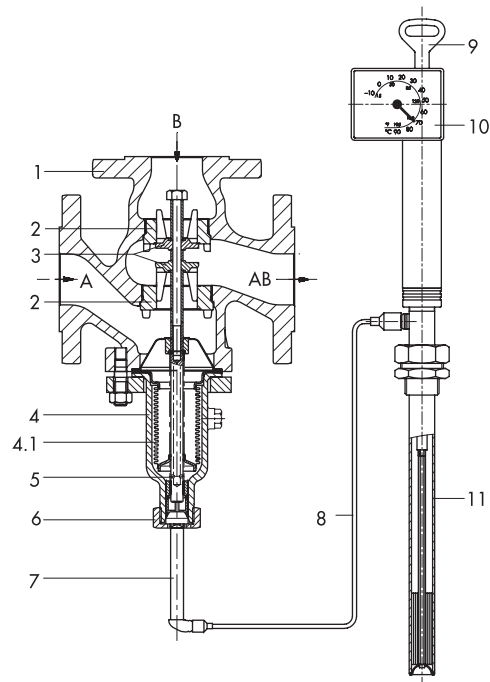


Fig. 3: Type 9 Temperature Regulator with three-way valve (NPS 2) and Type 2231 Control Thermostat, three-way valve with plug arrangement I, the arrows indicate mixing service

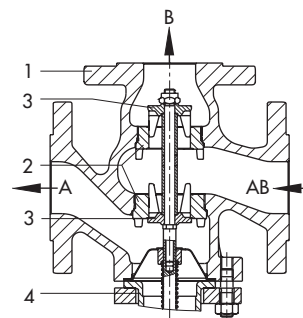


Fig. 4: Type 9 Temperature Regulator with three-way valve, with plug arrangement II, the arrows indicate diverting service

#### Three-way valve


- 1 Valve body
- 2 Seat (exchangeable)
- 3 Plug
- 4 Bottom section (bellows housing)
- 4.1 Balancing bellows
- 5 Plug stem with spring
- 6 Thermostat connection (threaded nipple with coupling nut)

#### Control thermostat

- 7 Operating element
- 8 Capillary tube
- 9 Set point adjustment key
- 10 Set point dial
- 11 Temperature sensor (bulb sensor)

**Table 1: Technical data**

All pressures are specified as gauge pressures. The listed permissible pressures and differential pressures are restricted by the specifications in the pressure-temperature diagram and the pressure rating.

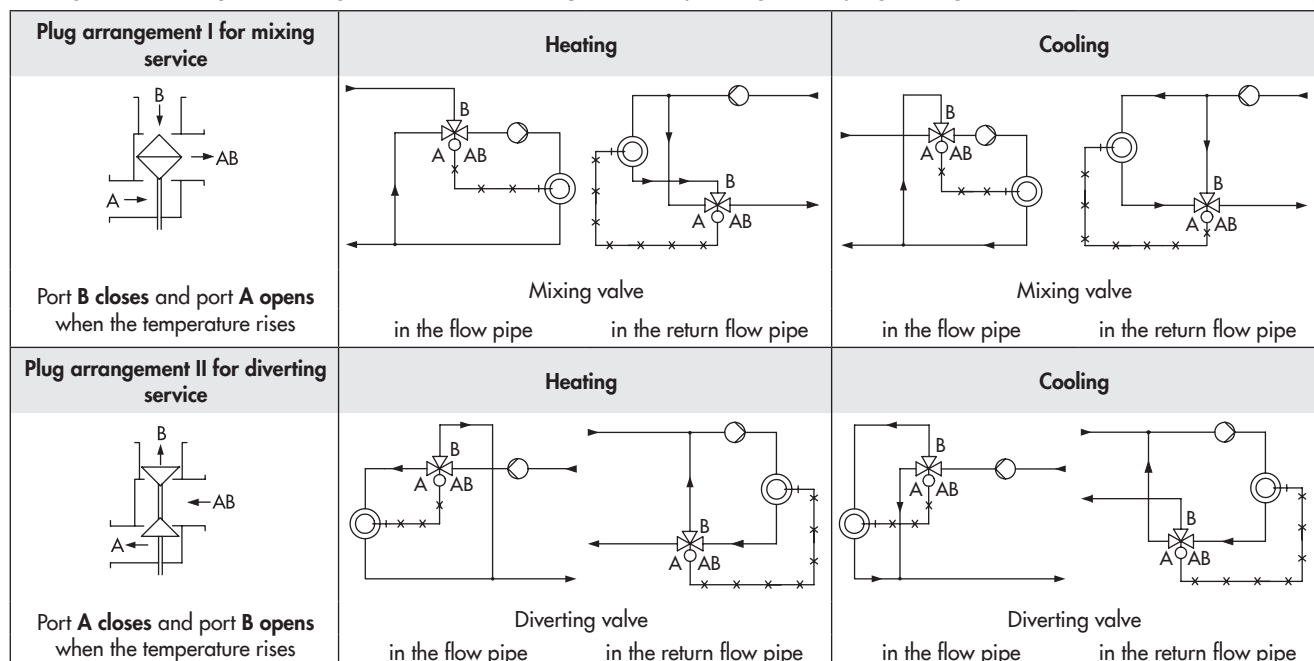
Type 2119 Three-way Valve											
Pressure rating		Class 150 and 300									
<b>K<sub>V5</sub> coefficients and max. permissible differential pressures Δp in bar</b>											
<b>Connection</b>		<b>NPS</b>	<b>½</b>	<b>¾</b>	<b>1</b>	<b>1½</b>	<b>2</b>	<b>2½</b>	<b>3</b>	<b>4</b>	<b>6</b>
Mixing valve	C <sub>V</sub> in gal/min	5	7.5	9.4	23	37	60	94	145	230	
	K <sub>V5</sub> coefficient in m <sup>3</sup> /h	4	6.3	8	16	32	50	80	125	200	
When p in B > p in A	Δp in psi	145			230			145			120
	Δp in bar	10			16			10			8
When p in A > p in B	Δp in psi	75			50			45			30
	Δp in bar	5			3.5			3			2
Diverting valve (when AB to A or B)	C <sub>V</sub> in gal/min	5	7.5	9.4	23	37	50	77	117	185	
	K <sub>V5</sub> coefficient in m <sup>3</sup> /h	4	6.3	8	16	32	40	64	100	160	
	Δp in psi	60			50			45			30
	Δp in bar	4			3.5			3			2
Permissible temperature of the valve		430 °F/660 °F (220 °C/350 °C). See pressure-temperature diagram in ► T 2010									
Compliance											
<b>Type 2231 to 2235 Thermostat</b>		<b>Size 150</b>									
Set point range (set point span 100 K)		15 to 195 °F, 70 to 250 °F or 120 to 300 °F · For Types 2232, 2234 and 2235 also 210 to 390 °F, 300 to 480 °F -10 to +90 °C, 20 to 120 °C or 50 to 150 °C · For Types 2232, 2234 and 2235 also 100 to 200 °C, 150 to 250 °C									
Perm. ambient temperature at the set point adjustment		-40 to +140 °F · -40 to +80 °C									
Permissible temperature at sensor		100 K above the adjusted set point									
Permissible pressure at sensor		Type 2231/2232 Without/with thermowell: Class 300 · Thermowell with flange: Class 150/300 Type 2233/2234 Without thermowell: Class 300 · With flange on request									
Capillary tube length		10 ft/3 m (special version: 16, 33, 50 ft/5, 10, 15 m)									

**Table 2: Materials · Material numbers according to DIN EN**

Type 2119 Three-way Valve		
Valve size	NPS ½ to 6	
Pressure rating	Class 150 and 300	
Body	Cast steel A216 WCC	Cast stainless steel A351 CF8M
Seat and plug	Steel 1.4006 (1.4301 in NPS 6)	
Plug stem/spring	1.4301/1.4310	
Balancing bellows <sup>1)</sup>	1.4571	
Bellows housing	1.0425	1.4571
Gasket	Graphite on metal core	
Extension piece/separating piece	Brass (special version: stainless steel 1.4301)	
Types 2231, 2232, 2233, 2234 and 2235 Thermostat <sup>2)</sup>		
	Standard version	Special version
Operating element	Nickel-plated brass	
Sensor	Type 2231/2232	Bronze
	Type 2233/2234	Copper
	Type 2235	Copper
Capillary tube	Nickel-plated copper	Plastic-coated copper or stainless steel 1.4571
Thermowell		
With threaded connection (1 NPT)		
Thermowell	Thermowell	Bronze, steel
	Threaded nipple	Brass
		Stainless steel 1.4571
With flanged connection (on request)		
Thermowell	Thermowell	Steel
	Flange	Steel
		Stainless steel 1.4571

<sup>1)</sup> NPS ½ to 1: without balancing bellows

<sup>2)</sup> Type 2235 not available in stainless steel version



### Typetested safety devices

The register number is available on request.

### The following versions are available:

**Temperature regulators (TR)** with a Type 2231, 2232, 2233, 2234 or Type 2235 Thermostat and a Type 2119 Three-way Valve in sizes NPS 1/2 to 6, for which the maximum operating pressure must not exceed the maximum permissible differential pressure  $\Delta p$  specified in the technical data.

Sensors without thermowell: applicable up to 600 psi (40 bar)

Sensors with thermowell: only use SAMSON 1 NPT version made of bronze or stainless steel 1.4571 up to Class 600 (40 bar).

Further details on the selection application of typetested equipment can be found in Information Sheet ▶ T 2040.

Additionally, the following are available:

**Safety temperature monitors (STM)** and **safety temperature limiters (STL)**. Details in Data Sheets ▶ T 2043 and ▶ T 2046.

### Dynamic behavior of the thermostats

The dynamics of the regulator are mainly determined by the response of the sensor with its characteristic time constant.

Table 3 lists the response times of SAMSON sensors operating according to different principles measured in water.

**Table 3:** Dynamic behavior of SAMSON thermostats

Functional principle	Control thermostat Type	Time constant [s]	
		Without Thermowell	With Thermowell
Liquid expansion	2231	70 s	120 s
	2232	65 s	110 s
	2233	25 s	– <sup>1)</sup>
	2234	15 s	– <sup>1)</sup>
	2235	10 s	– <sup>1)</sup>
	2213	70 s	120 s
Adsorption	2212	– <sup>1)</sup>	40 s

<sup>1)</sup> Not permissible

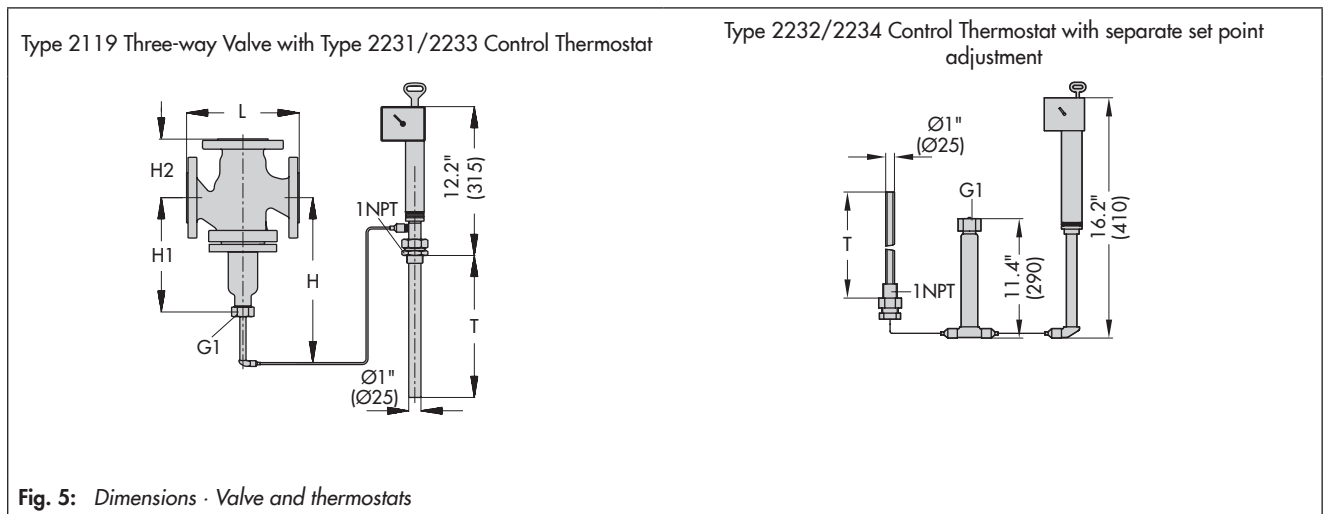
**Table 4:** Dimensions in mm and weights

Type 2119 Three-way Valve		NPS	1/2	3/4	1	1 1/2	2	2 1/2	3	4	6
L	Class 150	inch	7.25			8.75	10	10.9	11.75	13.9	17.75
		mm	184			222	254	276	298	352	451
	Class 300	inch	7.5	7.6	7.75	9.25	10.5	11.5	12.5	14.5	18.6
		mm	191	194	197	235	267	292	318	368	473
H2	Class 150	inch	3.6			4.4	5	5.4	5.9	6.9	8.9
		mm	92			111	127	138	149	176	225
	Class 300	inch	3.8	3.8	3.9	4.6	5.3	5.8	6.3	7.2	9.3
		mm	95.5	97	98.5	117.5	133.5	146	159	184	236.5
H1	Up to 430 °F	Without extension piece	9.25			9.5	9.7	12.6		14	19.7
	Up to 220 °C	mm	235			240	245	320		355	500
	Up to 660 °F	With extension piece	14.8			15	15.5	18.1		19.5	25.2
	Up to 350 °C	mm	375			380	385	460		495	640
H	Up to 430 °F	Without extension piece	20.7			20.9	21.1	24		25.4	31.1
	Up to 220 °C	mm	525			530	535	610		645	790
	Up to 660 °F	With extension piece	26.2			26.4	26.6	29.5		30.9	36.6
	Up to 350 °C	mm	665			670	675	750		785	930
Weight <sup>1)</sup>	approx. lb	13	15.5	17.5	33	37.5	68	82	108	On request	
	kg (approx.)	6	7	8.5	15	17	31	37	49		

Thermostat	Type	2231	2232	2233	2234	2235
Immersion depth T		11.4" (290 mm) <sup>2)</sup>	9.25" (235 mm) <sup>2)</sup>	16.9" (430 mm)	18.1" (460 mm)	136.2" (3460 mm)
Weight, approx.		7 lb (3.2 kg)	8.8 lb (4.0 kg)	7.5 lb (3.4 kg)	8.1 lb (3.7 kg)	7.9 lb (3.6 kg)

<sup>1)</sup> +10 % for Class 300

<sup>2)</sup> Larger immersion depths on request



**Fig. 5:** Dimensions · Valve and thermostats

**Ordering text**

**Type 9** Temperature Regulator/....,

NPS ...

Mixing or diverting valve, body material ..., Class ...

With Type ... Thermostat, set point range ...°F (°C)

Capillary tube ... ft (m)

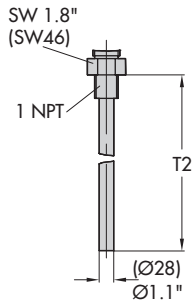
Optionally, special version ...

Optionally, accessories ...

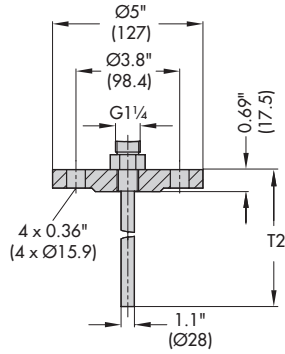
## Accessories

### Thermowells for Type 2231/2232

Thermostat	Type 2231	Type 2232
Length T2	12.6"	10"
	325 mm	250 mm

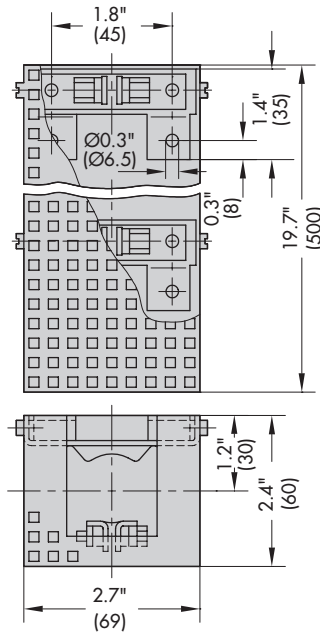


With threaded connection  
1 NPT/Class 300

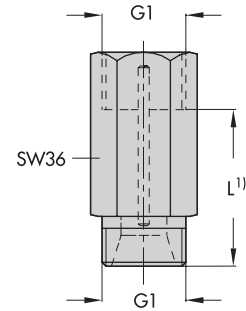


With flanges  
NPS 1½/Class 300

### Clamps and perforated cover for wall mounting



### Extension piece/separating piece



#### Extension piece

Standard version  
L = approx. 5.5" (140 mm),  
approx. 1.1 lb (0.5 kg),  
With bellows seal (special  
version),  
L = approx. 7.1" (180 mm),  
approx. 1.3 lb (0.6 kg),

**Separating piece** with seals,  
L = approx. 2.1" (55 mm),  
approx. 0.4 lb (0.2 kg),

¹) Add the dimension L to H and H1  
when these accessories are used.

Fig. 6: Accessories

## Accessories

**Thermowells** with threaded or flanged connections for Types 2231 and 2232 Bulb Sensors · 1 NPT threaded connection, Class 300, made of bronze/steel or CrNiMo steel  
NPS 1½ flanged connection, Class 300, with thermowell made of CrNiMo steel/steel

**Mounting parts** for Types 2233 and 2234 · Clamps for wall mounting · Perforated cover for thermostat

To protect the operating element from inadmissible operating conditions, an **extension piece** or **separating piece** must be installed between the valve and the operating element.

An **extension piece** is needed for temperatures over 430 °F (220 °C). The standard version does not have sealing. The special version of the extension piece for NPS ½ to 4 is made of stainless steel and has a bellows seal. It additionally acts as a separating piece.

**Separating piece** made of brass (for water and steam) or CrNi steel (for water and oil)

A separating piece must be used when a seal between thermostat and valve is required. Separating pieces made of CrNi steel must be used when all wetted parts are to be free of non-ferrous metals. In addition, it prevents the medium from leaking while the thermostat is being replaced.

**Manual adjuster Ma** with travel indicator · **MaS** with electric signal transmitter

**Reversing device** for NPS 2½ to 4 (item no. 1180-8098). Installed between thermostat connection and operating element with capillary tube. This allows the operating direction to be reversed when the regulator is installed incorrectly in the pipeline.

Specifications subject to change without notice



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