Add “Smarts” to Your Sensor
SmartPlug

Add “Smarts” to Your Sensor

SmartPlug makes your sensor or switch “Smart” by adding functionality to your signal output via a simple, teachable Plug and Work solution. Add functions such as timing, counting, speed monitoring or signal inversion by simply plugging the SmartPlug into your sensor or switch.

Programming is done via a simple “teach” input on the existing pin #2 of your existing M12x1 (eurofast ®) connector. The SmartPlug works with not only TURCK sensors, but with 3-wire DC sensors from many different manufacturers. For connection to sensors using M8x1 (picofast ®), or 7/8-16UN (minifast ®) connectors, adaptor cables are available.

SmartPlugs may be combined in series to provide multiple functions, such as a speed monitor with a time delay.

SmartPlug Features:

- Add function to existing installations.
- Solve control problems quickly in the field.
- Simple plug-in installation – uses industry standard M12x1 4-pin connectors (eurofast ®).
- Programmed through “teach” input – Pin 2. LED aids programming.
- All styles are 400 mA short-circuit-proof, noise immune switching amplifiers.
<table>
<thead>
<tr>
<th>Part Number</th>
<th>Function</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPC1-AP6X</td>
<td>Pulse or interval counters</td>
<td>4-5</td>
</tr>
<tr>
<td>SPC1-AN6X</td>
<td>Also used for:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- N.C./N.O. converter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 400 mA switching amplifier</td>
<td></td>
</tr>
<tr>
<td>SPF1-AP6X</td>
<td>Over or under speed monitors</td>
<td>6-7</td>
</tr>
<tr>
<td>SPF1-AN6X</td>
<td>Also used for:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 400 mA switching amplifier</td>
<td></td>
</tr>
<tr>
<td>SPN1-AP6-ARN6X</td>
<td>PNP to NPN converter</td>
<td>8-9</td>
</tr>
<tr>
<td>SPN1-AN6-ARP6X</td>
<td>Also used for:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- N.C./N.O. converter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 400 mA switching amplifier</td>
<td></td>
</tr>
<tr>
<td>SPT1-AP6X</td>
<td>On-delay or off-delay timer</td>
<td>10-11</td>
</tr>
<tr>
<td>SPT1-AN6X</td>
<td>Also used for:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Pulse stretching</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 400 mA switching amplifier</td>
<td></td>
</tr>
<tr>
<td>VB2-SP1</td>
<td>Molded pushbutton programmer</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>with connectors</td>
<td></td>
</tr>
</tbody>
</table>
SPC1-AP6X / SPC1-AN6X

Programmable pulse or interval counter
- Direct adaptation between sensor and connecting cable
- Counting of pulses or intervals
- Simple setting by external teach-input
- No additional wiring required
- Counting range from 0 to 65535
- Switching amplifier up to 400 mA
- N.C./N.O. inverter

The SPC1 SmartPlug is a freely programmable counter for the direct adaptation to sensors with a standardized M12x1 connection.

The SPC1 SmartPlug is available in 2 versions:
- PNP input - PNP output SPC1-AP6X (for use with PNP sensors)
- NPN input - NPN output SPC1-AN6X (for use with NPN sensors)

Connection:
The SmartPlug is very easy to connect; it is plugged onto the M12x1 connector of a sensor and the connecting cable is connected to the other side of the SmartPlug. The sensor configuration has to meet the standards (1+V (BN) 3 -V (BU) 4 output (BK)).

Setting:
The setting of the preset number is made by using the signals "teach input" and "input SmartPlug". If for example, 4 pulses have to be counted, the setting can be made as follows (operating voltage being switched on):
1. Connect teach input with +V.
2. Actuate the sensor 4 times (= 4 pulses) - The SmartPlug recognizes automatically 4 pulses at the "input SmartPlug".
3. Disconnect teach input from +V → READY.

After this setting, the output of the SmartPlug is activated every fourth pulse. The setting is maintained when the sensor is switched off.

H = input or output active; L = input or output inactive
When switching on the operating voltage, the counting procedure is reset. The initial state of the preset number is 1 (pulse counter).
Technical Data

<table>
<thead>
<tr>
<th>Operating Voltage</th>
<th>10-30 VDC, residual ripple of max. 10%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Own Current Consumption</td>
<td>&lt;10 mA</td>
</tr>
<tr>
<td>Input Resistance</td>
<td>&gt;10 kΩ</td>
</tr>
<tr>
<td>Max. Input Frequency</td>
<td>10 kHz</td>
</tr>
<tr>
<td>Min. Response Time</td>
<td>0.1 ms</td>
</tr>
<tr>
<td>Max. Output Current</td>
<td>400 mA short-circuit proof</td>
</tr>
<tr>
<td>Ambient Temperature Range</td>
<td>0° to +60°C (+32° to +140°F)</td>
</tr>
<tr>
<td>Storage Temperature Range</td>
<td>-20° to +60°C (-4° to +140°F)</td>
</tr>
<tr>
<td>Display</td>
<td>Red LED</td>
</tr>
<tr>
<td>Housing Material</td>
<td>Plastic PBTP/PA</td>
</tr>
<tr>
<td>Protection Standard</td>
<td>IP 67</td>
</tr>
<tr>
<td>Dimensions Inches[mm]</td>
<td>See diagram</td>
</tr>
<tr>
<td>Connection Input</td>
<td>4-pin socket M12x1</td>
</tr>
<tr>
<td>Connection Output</td>
<td>4-pin connector M12x1</td>
</tr>
<tr>
<td>Weight</td>
<td>15 g</td>
</tr>
</tbody>
</table>

Preset to factory setting 1 pulse counter

Wiring Diagrams

**SPC1-AP6X**

**SPC1-AN6X**

Application Examples:

1. Gearwheel/Divider: On a gearwheel with 100 teeth, one pulse per rotation is to be measured.
   a) A suitable sensor with standardized M12x1 connection is mounted in a way that each tooth is safely recognized.
   b) A SmartPlug SPC1 is connected between sensor and sensor connecting cable.
   c) The preset number 100 is taught into the SmartPlug. → connect "teach input" with +V, turn round the gearwheel exactly one time.
   d) Disconnect "teach input" from +V. READY
   At the output of the SmartPlug, one pulse per rotation is measured.

2. Counting parts: Bulk material is filled into cartons by means of a conveyor belt. The task is to specify the exact number of parts required to fill up the carton.
   a) A suitable sensor with standardized M12x1 connection is mounted in a way that all parts are safely recognized.
   b) A SmartPlug SPC1 is connected between sensor and sensor connecting cable.
   c) A "teach input" stays connected to +V until the desired number of parts has passed the sensor (=unit the carton is full).
   d) Disconnect "teach input" from +V. READY
   At the output of the SmartPlug, one pulse is measured when the preset quantity of parts has been recorded; the carton is full.

3. Switching amplifier: Most sensors have a maximum output current of 100 mA to 200 mA. By using a SmartPlug, the maximum output current can be increased to 400 mA.
   a) A SmartPlug SPC1 is connected between sensor and sensor connecting cable.
   b) The "teach input" stays connected to +V until the sensor has been actuated once (preset number 1).
   c) Disconnect "teach input" from +V. READY
   At the output of the SmartPlug every input pulse is measured, the output can be charged with 400 mA.

4. N.C./N.O. inverter: Teach the SmartPlug as interval counter "1". An input N.C. signal will be inverted into a N.O. signal and reverse.
SPF1-AP6X / SPF1-AN6X

Programmable over or under speed monitor
- Direct adaptation between sensor and connecting cable
- Teachable speed limit
- Simple setting by external teach-input
- No additional wiring required
- Frequency range 0.015 Hz - 1 kHz
- Output load up to 400 mA

The SPF1 SmartPlug is a frequency threshold module for the direct adaptation to sensors with a standard M12x1 connection. The SPF1 SmartPlug is available in 2 versions:
- PNP input - PNP output SPF1-AP6X (for use with PNP sensors)
- NPN input - NPN output SPF1-AN6X (for use with NPN sensors)

Connection:
The SmartPlug is very easy to connect; it is plugged onto the M12x1 connector of a sensor and the connecting cable is connected to the other side of the SmartPlug. The sensor configuration has to meet the standards (1 +V (BN) 3 -V (BU) 4 output (BK)).

Function:
The SmartPlug SPF1 observes the frequency of the signal at the pin "input SmartPlug". The output is activated if the setup frequency falls below approximately 5%.

Setting for under speed monitoring:
1. Set sensor up to sense object with SmartPlug SPF1 connected. Make sure sensor is sensing properly and output is switching.
2. Move object or set rotation to nominal speed.
3. Connect +voltage +V to "Teach Input" and then disconnect (turn off) voltage +V.
   (Pulse +V to Teach Input, >1 full cycle of senses object - e.g. >1 full revolution)
4. Done, if speed or frequency drops by 5% or 95% of nominal speed, then SmartPlug is activated.

Setting for over speed monitoring:
(Note: over speed output will be inverted. i.e. output activated for normal speed & output off for over speed.)
1. Set sensor up to sense object with SmartPlug SPF1 connected. Make sure sensor is sensing properly and output is switching.
2. Move object to set rotation to 106% plus X% over speed allowance of nominal speed.
3. Connect +voltage +V to "Teach Input" and then disconnect (turn off) voltage +V.
   (Pulse +V to Teach Input, >1 full cycle of senses object - e.g. >1 full revolution).
4. Done. If speed or frequency goes above setpoint, then SmartPlug output goes off.
### Technical Data

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Voltage:</td>
<td>10-30 VDC, residual ripple of max. 10%</td>
</tr>
<tr>
<td>Own Current Consumption:</td>
<td>&lt;10 mA</td>
</tr>
<tr>
<td>Input Resistance:</td>
<td>&gt;10 kΩ</td>
</tr>
<tr>
<td>Max. Input Frequency:</td>
<td>10 kHz</td>
</tr>
<tr>
<td>Min. Response Time:</td>
<td>0.1 ms</td>
</tr>
<tr>
<td>Max. Output Current:</td>
<td>400 mA short-circuit proof</td>
</tr>
<tr>
<td>Ambient Temperature Range:</td>
<td>0° to +60°C (+32° to +140°F)</td>
</tr>
<tr>
<td>Storage Temperature Range:</td>
<td>-20° to +60°C (-4° to +140°F)</td>
</tr>
<tr>
<td>Display:</td>
<td>Red LED</td>
</tr>
<tr>
<td>Housing Material:</td>
<td>Plastic PBTP/PA</td>
</tr>
<tr>
<td>Protection Standard:</td>
<td>IP 67</td>
</tr>
<tr>
<td>Dimensions Inches[mm]:</td>
<td>See diagram</td>
</tr>
<tr>
<td>Connection Input:</td>
<td>4-pin socket M12x1</td>
</tr>
<tr>
<td>Connection Output:</td>
<td>4-pin connector M12x1</td>
</tr>
<tr>
<td>Weight:</td>
<td>15 g</td>
</tr>
</tbody>
</table>

### Applications Examples:

1. Jam detection
2. RPM Observation
3. Conveyor built back detection
4. Cooling fan motion control

![SPF1-AP6X Diagram](image1)

![SPF1-AN6X Diagram](image2)

![Dimensions Diagram](image3)
SPN1-AP6-ARN6X / SPN1-AN6-ARP6X

PNP/NPN or NPN/PNP converter, adjustable N.O./N.C. inverter

- Direct adaptation between sensor and connecting cable
- N.C./N.O. function adjustable
- Simple setting via external teach-input
- No additional wiring required
- Switching frequency up to 10 kHz
- Switching amplifier up to 400 mA

The SPN1 SmartPlug is a switching channel convertor for the direct adaptation to sensors with a standard M12x1 connection.

The SPN1 SmartPlug is available in 2 versions:

- PNP input - NPN output SPN1-AP6-ARN6X (for the conversion of PNP sensors to NPN output)
- NPN input - NPN output SPN1-AN6-ARP6X (for the conversion of NPN sensors to PNP output)

Connection:
The SmartPlug is very easy to connect: it is plugged onto the M12x1 connector of a sensor and the connecting cable is connected to the other side of the SmartPlug. The sensor configuration has to meet the standards (1 +V (BN) 3 -V (BU) 4 output (BK)).

```
+V  +V1
  4
  2
 1
 2
 3
- V
```

Function:
The SmartPlug SPN1-AP6-ARN6X converts a PNP input signal into a NPN output signal. The SmartPlug SPN1-AN6-ARP6X converts a NPN input signal into a PNP output signal. Additionally the signal can be inverted (N.C./N.O. function).

Setting:
The setting of the inverting function is made by means of the signals "teach input" and "input SmartPlug"

Example:
1. Setting the SmartPlug into the inverting mode:
   a) activate sensor (output is on)
   b) connect teach input and +V and disconnect (pulse or signal to +V). READY

2. Setting the SmartPlug into the non-inverting mode (factory setting)
   a) inactivate Sensor (output is off)
   b) connect teach input and +V and disconnect (pulse or signal to +V). READY

This setting is maintained when the sensor is off.
Technical Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Voltage:</td>
<td>10-30 VDC, residual ripple of max. 10%</td>
</tr>
<tr>
<td>Own Current Consumption:</td>
<td>&lt;10 mA</td>
</tr>
<tr>
<td>Input Resistance:</td>
<td>&gt;10 kΩ</td>
</tr>
<tr>
<td>Max. Input Frequency:</td>
<td>10 kHz</td>
</tr>
<tr>
<td>Min. Response Time:</td>
<td>0.1 ms</td>
</tr>
<tr>
<td>Max. Output Current:</td>
<td>400 mA short-circuit proof</td>
</tr>
<tr>
<td>Ambient Temperature Range:</td>
<td>0° to +60°C (+32° to +140°F)</td>
</tr>
<tr>
<td>Storage Temperature Range:</td>
<td>-20° to +60°C (-4° to +140°F)</td>
</tr>
<tr>
<td>Display:</td>
<td>Red LED</td>
</tr>
<tr>
<td>Housing Material:</td>
<td>Plastic PBTP/PA</td>
</tr>
<tr>
<td>Protection Standard:</td>
<td>IP 67</td>
</tr>
<tr>
<td>Dimensions Inches[mm]:</td>
<td>See diagram</td>
</tr>
<tr>
<td>Connection Input:</td>
<td>4-pin socket M12x1</td>
</tr>
<tr>
<td>Connection Output:</td>
<td>4-pin connector M12x1</td>
</tr>
<tr>
<td>Weight:</td>
<td>15 g</td>
</tr>
</tbody>
</table>

H = input/output active
L = input/output inactive

Function | SmartPlug | Setting |
----------|-----------|---------|
PNP / NPN converter | SPN1-AP6-ARN6X | Factory setting |
NPN / PNP converter | SPN1-AN6-ARP6X | Factory setting |
PNP / NPN converter and N.C. / N.O. inverter | SPN1-AP6-ARN6X | Setup: N.O. → N.C. |
NPN / PNP converter and N.C. / N.O inverter | SPN1-AN6-ARP6X | Setup: N.O. → N.C. |
Programmable timer for on-delay time or off-delay time

- Direct adaptation between sensor and connecting cable
- Teachable as on-delay time or off-delay time
- Simple setting by external teach-input
- No additional wiring required
- Time range between 1 and 65535 ms
- Switching amplifier up to 400 mA
- Can be used as pulse stretcher

The SPT1 SmartPlug is a freely programmable timer for the direct adaptation to sensors with a standardized M12x1 connection.

The SPT1 SmartPlug is available in 2 versions:
- PNP input - PNP output SPT1-AP6X (for use with PNP sensors)
- NPN input - NPN output SPT1-AN6X (for use with NPN sensors)

Connection:
The SmartPlug is very easy to connect: it is plugged onto the M12x1 connector of a sensor and the connecting cable is connected to the other side of the SmartPlug. The sensor configuration has to meet the standards (1 +V (BN)  3 -V (BU)  4 output (BK) ).

Setting:
The setting of the delay time is made by means of the signals "Teach input" and "Input SmartPlug". A delay time of 4 seconds for example can be set as follows (the operating voltage being switched on):
1. Connect teach input with +V
2. Actuate sensor for 4 seconds
3. Disconnect teach input from +V. READY

After this setting the SmartPlug has a slow operation lasting 4 seconds. This setting is maintained when the sensor is switched off.

When switching on the operating voltage, the timer is reset. The initial state of the preset time is 100 ms off-delay.
H = input/output active  L = input/output inactive
Technical Data

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Voltage:</td>
<td>10-30 VDC, residual ripple of max. 10%</td>
</tr>
<tr>
<td>Own Current Consumption:</td>
<td>&lt;10 mA</td>
</tr>
<tr>
<td>Input Resistance:</td>
<td>&gt;10 kΩ</td>
</tr>
<tr>
<td>Max. Input Frequency:</td>
<td>10 kHz</td>
</tr>
<tr>
<td>Min. Response Time:</td>
<td>0.1 ms</td>
</tr>
<tr>
<td>Max. Output Current:</td>
<td>400 mA short-circuit proof</td>
</tr>
<tr>
<td>Ambient Temperature Range:</td>
<td>0° to +60°C (+32° to +140°F)</td>
</tr>
<tr>
<td>Storage Temperature Range:</td>
<td>-20° to +60°C (-4° to +140°F)</td>
</tr>
<tr>
<td>Display:</td>
<td>Red LED</td>
</tr>
<tr>
<td>Housing Material:</td>
<td>Plastic PBTP/PA</td>
</tr>
<tr>
<td>Protection Standard:</td>
<td>IP 67</td>
</tr>
<tr>
<td>Dimensions Inches [mm]:</td>
<td>See diagram</td>
</tr>
<tr>
<td>Connection Input:</td>
<td>4-pin socket M12x1</td>
</tr>
<tr>
<td>Connection Output:</td>
<td>4-pin connector M12x1</td>
</tr>
<tr>
<td>Weight:</td>
<td>15 g</td>
</tr>
</tbody>
</table>

To preset to factory setting 100 ms off-delay

```
    teach input    H   L
    input         H   L
    SmartPlug     H   L
    output        H   L
    SmartPlug     H   L

    t > 10 s
    preset done
```

or

```
    teach input    H   L
    input         H   L
    SmartPlug     H   L
    output        H   L
    SmartPlug     H   L

    t > 10 s
    preset done
```

SPT1-AP6X

```
  +V
  1
  2
  3
  4

  SmartPlug

  NPN
  -V
```

SPT1-AN6X

```
  +V
  1
  2
  3
  4

  SmartPlug

  PNP
  -V
```

Dimensions:

- M12x1: 2.362 [60.0] mm
- M12x1: 0.787 [20.0] mm
- .472 [12.0] mm
SmartPlug Programming Push Button

VB2-SP1

Dimensions

Pinouts

<table>
<thead>
<tr>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-pin</td>
<td>4-pin</td>
</tr>
</tbody>
</table>

Wiring Diagram

Momentary PB Switch

Branch 1 (RS 4.4T)

Branch 2 (RK 4.4T)
TURCK Inc. sells its products through Authorized Distributors. These distributors provide our customers with technical support, service and local stock. TURCK distributors are located nationwide - including all major metropolitan marketing areas.

For Application Assistance or for the location of your nearest TURCK distributor, call:

1-800-544-PROX (1-800-544-7769)

Specifications in this manual are subject to change without notice. TURCK also reserves the right to make modifications and makes no guarantee of the accuracy of the information contained herein.

Literature and Media questions or concerns?
Contact Marketing Services at TURCK USA: media@turck.com
New Literature from TURCK

Proximity Sensors  B2000
Cordsets  B2001
Automation Controls  B0154

Flow & Temperature  B0155
Die Guard  B1777
EZ-Track  B0310

Capacitive Sensors  B0149
Q-pak  B0143
Pressure Sensors  B0148
The Industry Leader in Proximity Sensing, Cordsets and Interface Technology

**Proximity Sensors**
Industry’s broadest line of inductive and capacitive proximity sensors.

**Cordsets and Junctions**
Cordsets and junction boxes for connection to most popular switch and sensor styles.

**Flow Monitors**
Monitors for sensing the flow of liquids and gases during industrial processes.

**Pressure Sensors**
A complete line of solid state, programmable pressure sensors.

**EZ-Track LDT’s**
Programmable Linear Displacement Transducers in a compact low profile housing.

**Interface Devices**
Interface and logic products for automation and intrinsically safe environments.

Contact us or visit our website for our latest literature.

**Sensor Products**
email: sensors@turck.com

**Cordset and Junction Products**
email: cordsets@turck.com

**Intrinsic Safety Products**
email: barriers@turck.com

---

**TURCK USA**
TURCK Inc.
3000 Campus Drive
Minneapolis, MN 55441
Phone: (763) 553-7300
FAX: (763) 553-0708
Application Support: 1-800-544-PROX (7769)

**TURCK Canada**
CHARTWELL ELECTRONICS, INC.
140 Duffield Drive
Markham, Ontario
Canada, L6G 1B5
Phone: (905) 513-7100
FAX: (905) 513-7101

**TURCK Mexico**
ICESA - MODICON
Ant. Camino a Sta. Monica No. 7
San Lucas Tepetlalacalco
54050 Tlalnepantla
Edo. de Mexico
Phone: (52) 5-397 8644
FAX: (52) 5-398 9888

Printed in USA