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PICOTURN®

Data Sheet

PT2G Series

Smart Sensor System for the Turbocharger Speed 2nd Generation

16th February 2012

Document-No.: DB_PT2G V1.4.1

1 PT2G Series - Product List

Part No.	Product	Description			
Intelligent sensors with integrated signal processing and TTL output					
		Sensor length / Thread length	Diameter	Cable length	Temperature range sensor head
1537	PT2G-SM5.3	60 mm / 54 mm	M5 x 0.8	0.95 m	-40°C to +230°C
1591	PT2G-SM5.5	46 mm / 40 mm	M5 x 0.8	0.95 m	-40°C to +230°C
1660	PT2G-SM5.6	75 mm / 69 mm	M5 x 0.8	0.95 m	-40°C to +230°C
1590	PT2G-SM5F.2	41 mm / 25 mm	M5 x 0.5	0.95 m	-40°C to +230°C
1538	PT2G-SM5F.3	56 mm / 40 mm	M5 x 0.5	0.95 m	-40°C to +230°C
1666	PT2G-SM5F.5	76 mm / 60 mm	M5 x 0.5	0.95 m	-40°C to +230°C
Accessories					
1526	PT2G-BX	Power supply and Signal conditioning box with RS232 interface			
1527	PT2G-BD	Power supply and Signal conditioning box with display			
1771	PT2G-XS-01.5	Adapter cable, interconnecting PT2G-SM... sensor and PT2G-B... signal conditioning box			1.5 m length
1569	PT2G-XS-03				3 m length
1539	PT2G-XS-05				5 m length
1540	PT2G-XS-10				10 m length
1541	PT2G-C-2B	Power supply cable, 4 mm “banana” connectors, 2 m length			
1542	PT2G-C-2U	Power supply cable, open end, 2 m length			
1659	PT2G-C-2B&2BNC	Combination Cable for power Supply and signals (2 x BNC, 2 x “banana” 4 mm), length 3 m / 3.6 m			
1543	PT2G-X-CT	Cable, interconnecting PT2G-B... box and PICOTURN-CT calibration device			
1767	PT2G-C-BNCM8	Cable, connecting PT2G-BD as a display box to a PTBM box. 1 m length			
1684	PT2G-C-CSM2M	Cable, connecting one PT2G sensor to a “CNTMM“ counter minimodule by CSM GmbH, length 2m (also available in 10 m)			
1963	PT2G-C-ETAS_E441	Cable connecting two sensors PT2G to one “E441“ module by ETAS GmbH, length: 2 m			
1667	PT2G-C-IPTRKLM	Cable, connecting one PT2G sensor to an IPETRONIK “SIM-CNT“ or “M-FRQ“ counter module			

2 The System And Its Advantages

PICOTURN® is a system for measuring the rotational speed of turbo chargers. Its functional principle is one-megahertz pulse induction and eddy current discrimination, done with a solenoid sensor that is mounted in the compressor housing through a bore. The sensor detects and counts compressor vanes one by one.
When compared to optical detection, this inductive method benefits from its lack of sensitivity to dirt, oil and dust. When compared to the magnetized nut method, the PICOTURN system is safer as there is no concern with nuts coming loose and destroying the charger and the engine. When compared to a competing, entirely analog inductive vane counting system, the fully digital PICOTURN device turns out to be rugged, reliable, simple to use and very cost-effective.

Since 2001 PICOTURN in its original “first” generation has proven advantages in prototype vehicles and on engine test benches. It has been successfully used in passenger cars and in commercial vehicles. Made up of discrete electronic components, it has been developed in a continuous improvement process up to its sixth version (“PTBM-V6”). To continue the improvement, it was necessary to achieve a higher degree of integration by creating a dedicated CMOS integrated circuit (“chip” or “ASIC”) and as a result of this chip, the PICOTURN Second Generation (“PT2G”) was developed.

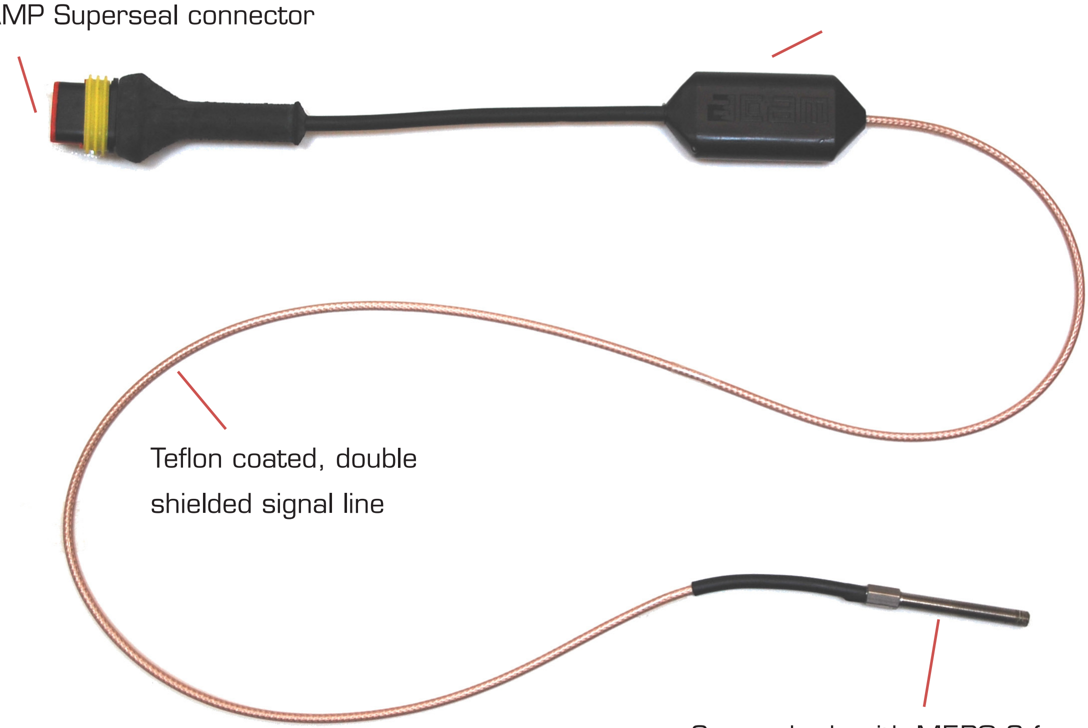
In the PT2G, part of the remote electronics has now been placed close to the sensor body for under-hood operation. Consequently, cable length and placement of the box have ceased to be an issue. Passenger car engineers can now place the box in the trunk, while the commercial car engineers can now use a 10 meter cable and loop it around the cabin hinge.

A further advantage of this new, second generation system is the wealth of interfaces available reducing the number of devices and cables needed. This is particularly useful in vehicles. When used in a bi-turbo environment, unique solutions occur that may be advantageous to many customers (i.e. directly connecting sensor elements to commercially available frequency counters providing two or more entry channels). This kind of counter solution is somewhat expensive, so most customers are likely to prefer the inexpensive, dedicated PICOTURN conditioner box offered by ACAM. The measuring chain will then comprise the sensor element, the box and two signal cables plus one supply cable. Alternatively, a combined cable may be used that integrates the supply line. A "combi connector" will then be used instead of the BNC connectors from the First Generation system, which are still present. Furthermore, the customer will choose between pulse-coded, analog voltage coded, or alphanumeric data output (for alphanumeric, opt for the "RS-232" version of the box).

As before, the sensor solenoid is housed in a M5 threaded sleeve with two different pitches and various lengths available. Unlike earlier first generation versions (PTBM-V1 to V6), the second generation system is no longer compatible with earlier components. First and second generation components must be handled separately. Sensor placement and system operation in general, however, remain unchanged.

3 System Components

3.1 The Sensor Element



Sensor reference code:
PT2G-SM.... (see page 2)

3 System Components

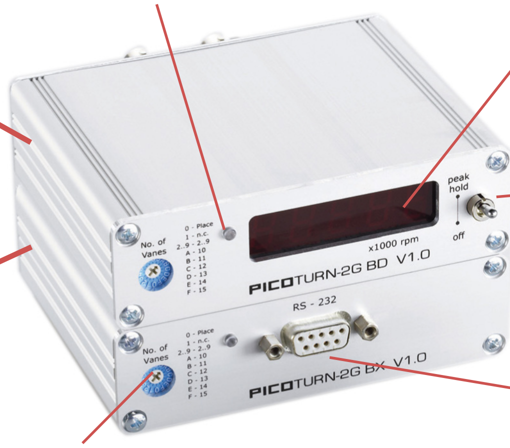
3.2 The "Box", Providing Power, Signal Conditioning And Various Interfaces

Like in the PICOTURN first generation system, the conditioner electronics has been placed in a light grey aluminium housing having the same BNC connectors and vane number selector as before. The female supply plugs have been removed for safety reasons. Instead, there is a 5-pole combination connector integrating power supply and interfaces, wired in parallel to the BNC connectors. Last but not least, the system still has a diagnostics LED, but with re-defined signal codes. Unlike the First Generation system, there is now an integrated seven-segment numeric display, which has the option of being replaced by a computer connector (9-pole D-Sub) for numeric data output.

LED for diagnostics

Variant with display **Ref. PT2G-BD**

LED 7-segment display



Peak-hold switch

Variant without display but with D-Sub-9 **Ref. PT2G-BX**

9-pole D-Sub connector, numeric data interface with RS-232

Number-of-vane code switch

Backside both box variants

5-pole threaded plug connector for supply input and for interface output (wired in parallel to the BNC outputs)

3-pole threaded plug connector for the sensor element

Output #2, BNC digital pulses

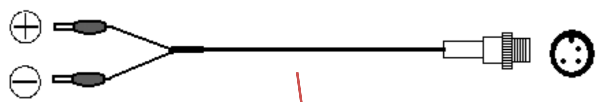
Output #1, BNC analog

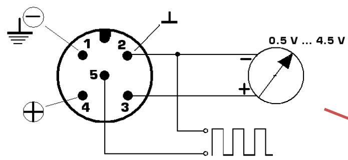
3 System Components

3.3 Standard Cables, Pin Assignment

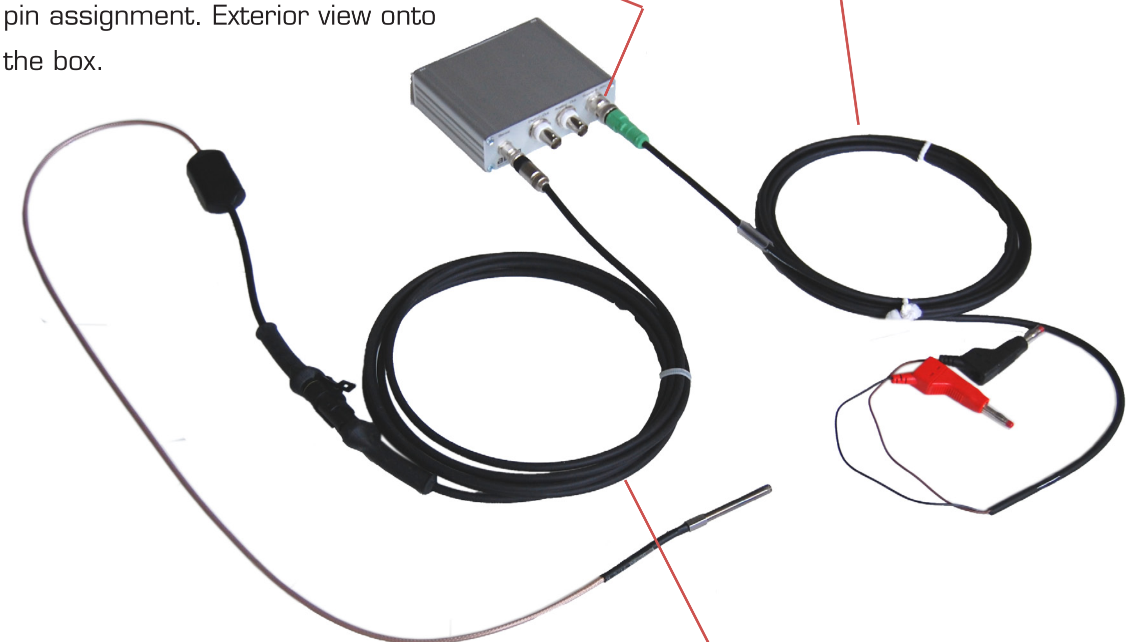
Supply cable with or without 4 mm plugs,
2 meters in length

Ref. PT2G-C-2B





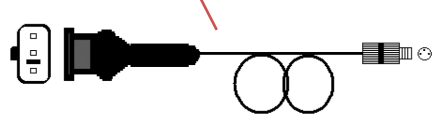
M12-thread 5-pole combi connector pin assignment. Exterior view onto the box.

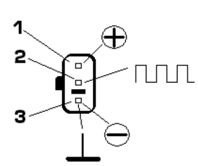


Adapter cable between sensor element and conditioner box. Length 3 meters, 10 meters etc.

Ref. PT2G-XS-xx

xx = length in meter (01.5, 03, 05, 10)

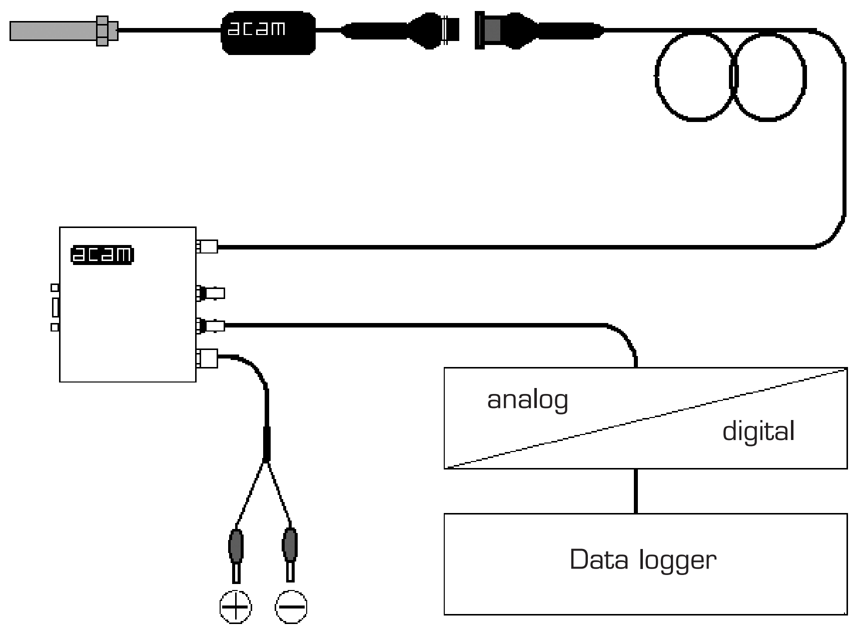


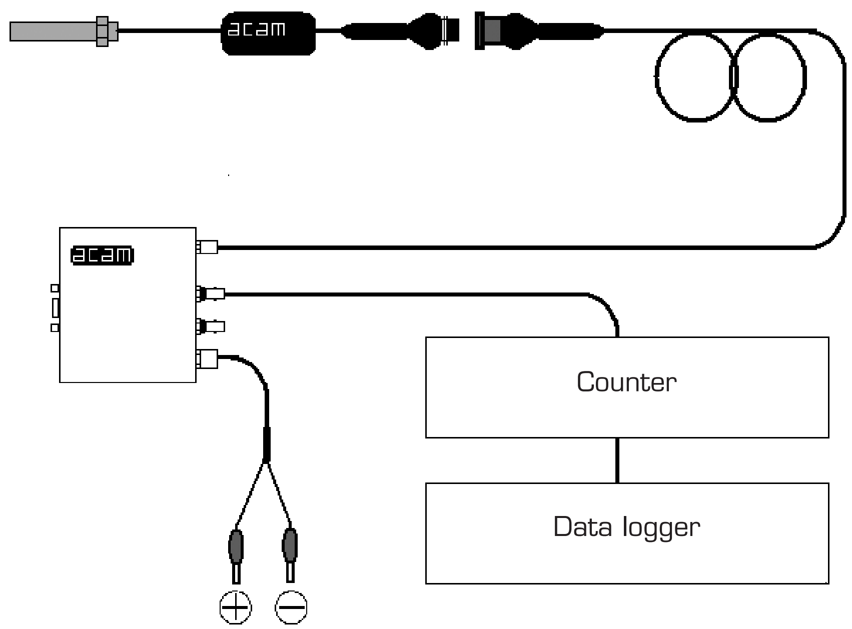


4 Connecting Options

4.1 Standard Wiring

This wiring corresponds to the well-known PICOTURN first generation system

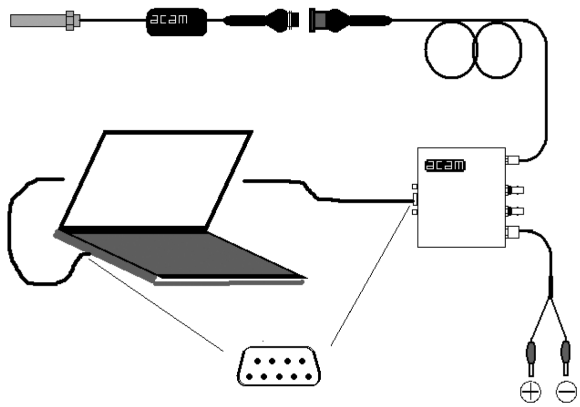




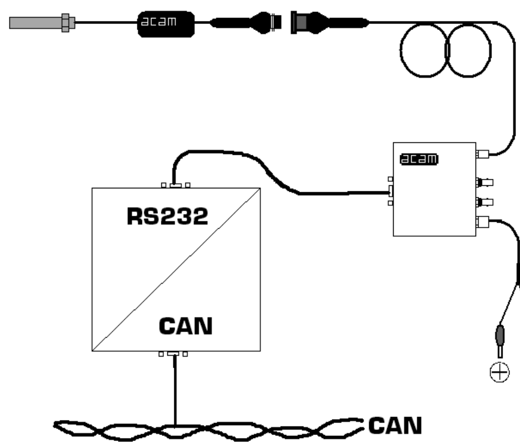
4 Connecting Options

4.2 Other Connection Possibilities

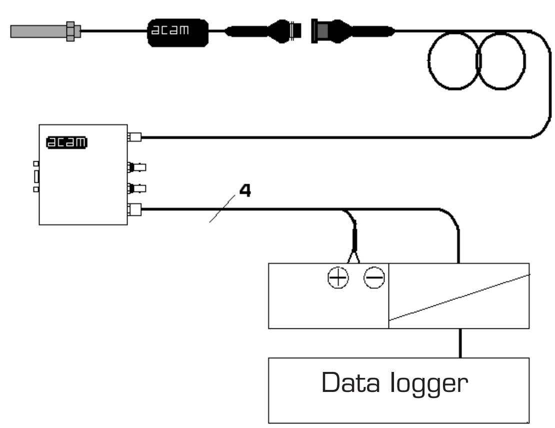
Laptop computer, via
RS-232 at D-Sub, 9-pole



Easy, simple and inexpensive
PicoTurnto-CAN bus solution



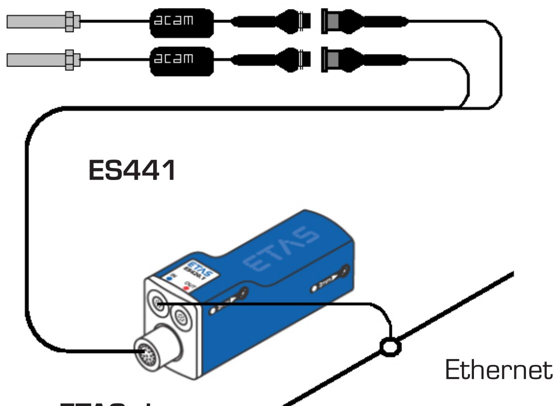
Combined cable
(antispaghetti) solution



4 Connecting Options

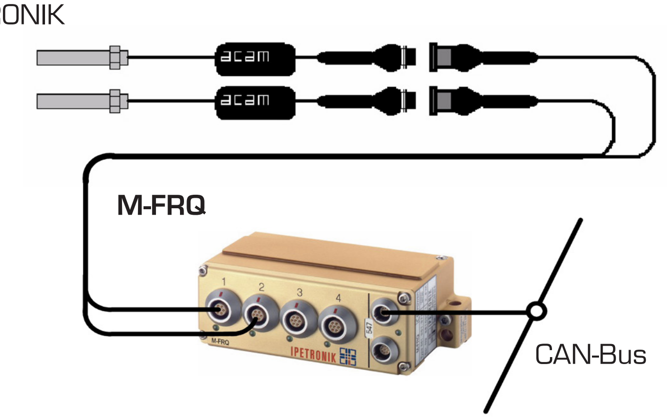
4.3 Vendor Independent Connecting Options

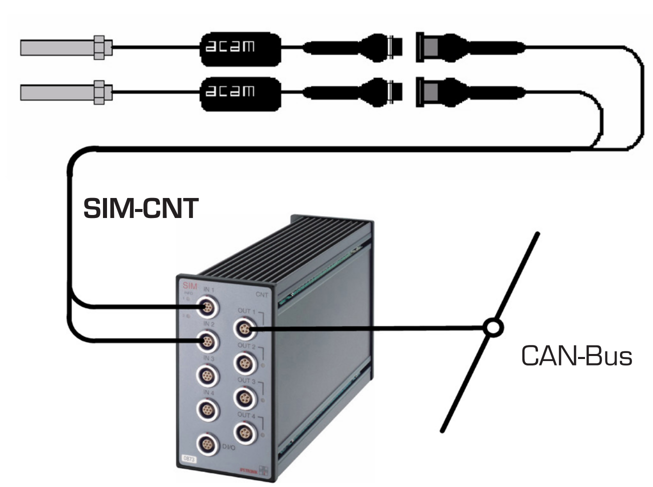
4.3.1 ETAS



www.ETAS.de

4.3.2 IPETRONIK

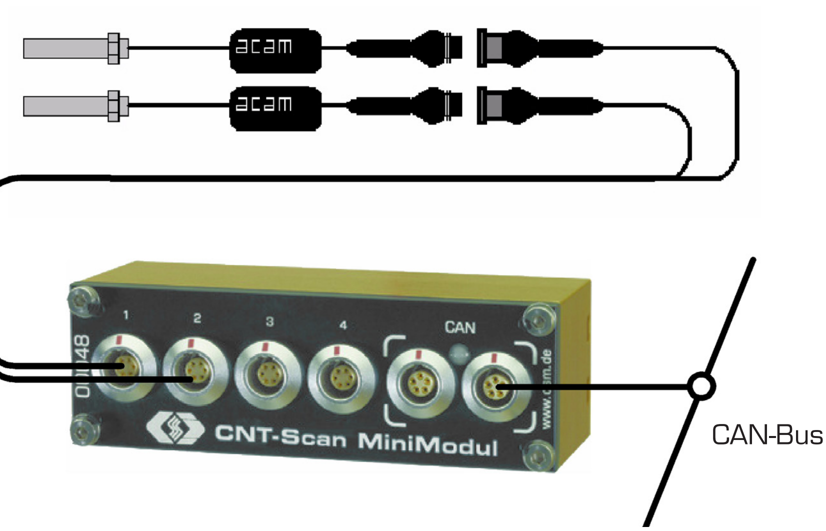




www.IPETRONIK.com

4 Connecting Options

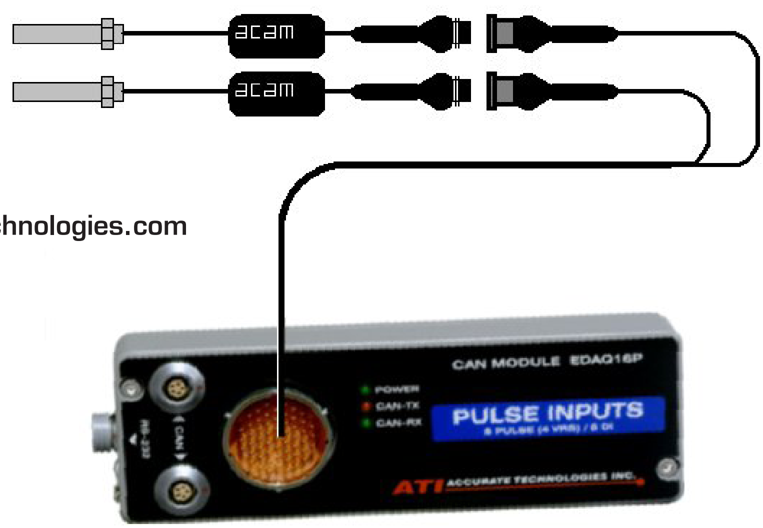
4.3.3 CSM



MiniModul

www.CSM.de

4.3.4 ATI Accurate Technologies Inc.

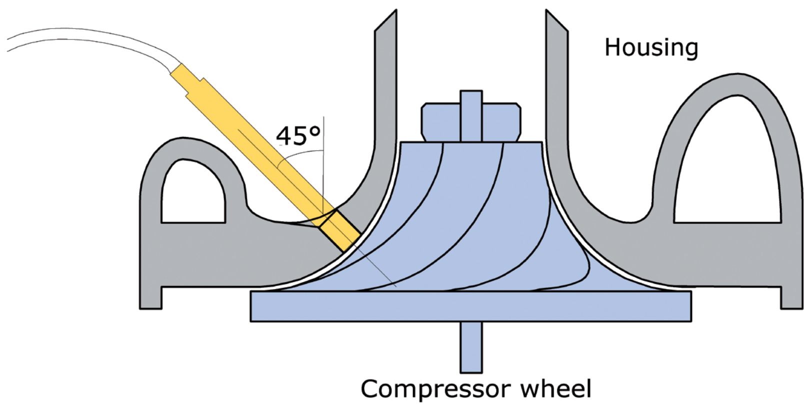


www.accuratetechnologies.com

5 Sensor Application

The sensor body should be mounted as indicated (see sketch below). Do not try to sense only every second vane. Instead sense all the vanes, both big and small. Place the sensor directly in front of the small vanes ("splitter vanes"), avoiding the vicinity of their upper edge (which could induce error into the system). The system is programmed to sense alternately thicker and thinner vanes.

Lock torque: Important. The sensor body is not a 5 millimeter bolt, but merely a sleeve with some 0.3 mm thick walls. Apply only a fraction of the torque you would with a solid bolt, 0.3 Nm maximum (finger force, not fist force).



Environment: The sensor element with respect to its electronics and "superseal" connector has been designed for under-hood operation and is considered engine compartment tolerant.

6 Technical Data

Table 1: Sensor Tip To Compressor Vane Distance

Sensor/vanes distance	Passenger Cars	Commercial Vehicles
Minimum	not known, probably zero	approx. 0.5 mm
Maximum	approx. 1 mm	approx. 1.5 mm

These are approximate values for aluminium compressor wheels. Exact values depend on turbocharger geometry.

Table 2: Other Operating Conditions

Supply voltage (box)	9 to 36 volts DC	
Consumption (box)	-BX (RS-232 option)	36 mA @ 24 V + 20 mA**
	-BD (display option)	59 mA @ 24 V + 20 mA**
Temperature (box)	–40 °C to +85 °C (–40 °F to +185 °F)	
Dimensions (box)	105 mm x 85 mm x 30 mm	
Temperature (sensor element)	Cable and electronics	–40 °C to +125 °C (257 °F)
	Sensor tip	–40 °C to +230 °C* (446 °F)
Dimensions (sensor body)	Fine thread M5x0.5 with various lengths 25 mm to 60 mm	
	Standard thread M5x0.8 with various lengths 40 mm to 70 mm	
Length of sensor element and its cable	From body to ASIC	approx. 0.75 meter
	From ASIC to "Superseal"	approx. 0.12 meter
	Total length sensor element	approx. 1.00 meter

* Excess temperature tolerated for short periods
** Sensor

6 Technical Data

Table 3: Signal Output And Metrological Characteristics

<table>
<tr><th>Interface</th><th>Specification</th><th>Remarks</th></tr>
<tr><td>Analog-Out (voltage)</td><td>Analog voltage
0.5 to 4.5 volts
0.5 volts = standstill
4.5 volts = 320,000 r.p.m. subject to correct vane number setting</td><td>The output is set parallel between the BNC connector and the M12 combi connector
<table>
<tr><td>Range</td><td>0.5 to 4.5 volts</td></tr>
<tr><td>Slope</td><td>80,000 r.p.m./volt (subject to correct vane number setting)</td></tr>
<tr><td>Measurement rate</td><td>approx. 260 Hz</td></tr>
<tr><td>Resolution</td><td>390 r.p.m. when set to 10 vanes</td></tr>
<tr><td>Precision</td><td>0.25 % end of scale</td></tr>
</table></td></tr>
<tr><td>Digital- Out (Pulses)</td><td>CMOS
5V / 10 mA
one impulse per revolution subject to correct vane number setting</td><td>The output is set parallel between the BNC connector and the M12 combi connector
<table>
<tr><td>Minimum speed</td><td>approx. 390 r.p.m.</td></tr>
<tr><td>Maximum speed</td><td>approx. 400'000 r.p.m.</td></tr>
<tr><td>Precision</td><td>approx. 390 r.p.m.</td></tr>
</table></td></tr>
<tr><td>Numeric output in ASCII over RS-232</td><td>Transfer rate
38400 baud,
8 bits,
no parity,
1 stop bit („8N1“)</td><td>Unidirectional interface, for measurement result output only. May be read with any port monitor including freeware (e.g. Putty.exe). Output format:
<table>
<tr><td>Time stamp</td><td><Space></td><td>Measured value</td><td><CR> <LF></td></tr>
</table>
Subject to correct vane number setting, the output reads revolutions per minute. The time stamp is in multiples of T = 3.84 ms. / Other: see Analog and Digital above.</td></tr>
</table>

Charging an interface with current may cause the box to consume more than nominal value.

6 Technical Data

Table 4: Number-of-Vanes Setting

code switch	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
without jumper	place	n. c.	2	3	4	5	6	7	8	9	10	11	12	13	14	15
with jumper	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

Code switch setting 0 without a jumper means „place mode“. This is a particular mode for adjusting the sensor-object distance. The alternative meaning (last line of the table) is obtained after setting a jumper inside the box, see photograph at page 17.

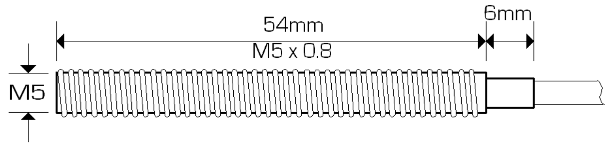
Table 5: Diagnostics Light Emitting Diode

Mode	LED colour	Sensor element connected ?	Turbocharger state	Meaning
Measure-ment mode	black	no	indifferent	Supply or box n.ok
		yes	idle	Sensor element ok (1)
		yes	spinning (2)	Distance too big (1)
	red (3)	no	indifferent	Supply & box ok
	red (3)	yes	indifferent	Sensor element defective
	green	yes	spinning (2)	Whole chain ok
“Place“-mode	red (3)	yes	spinning (2)	Signal too weak/noisy
	green			Distance & signal ok

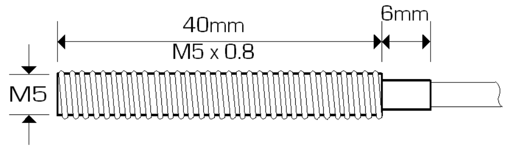
(1) provided, the LED turns red upon disconnecting the sensor
(2) to get the compressor wheel spinning, drive it with compressed air. The speed and the sense of the rotation are indifferent.
(3) disrupt the supply from time to time, as the system may freeze in the “LED red“ state.

Dimensions:

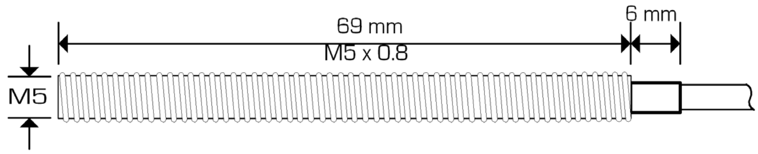
PT2G-SM5.3



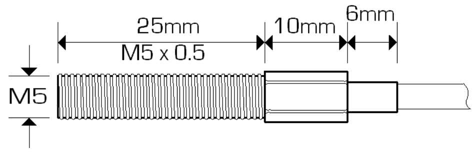
PT2G-SM5.5



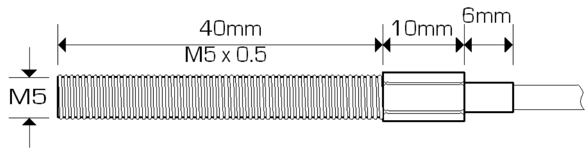
PT2G-SM5.6



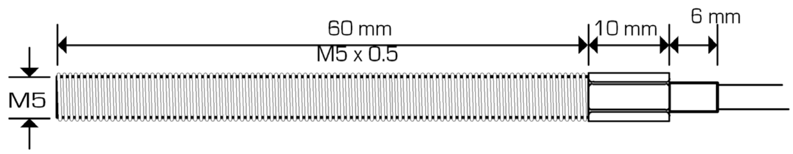
PT2G-SM5F.2



PT2G-SM5F.3



PT2G-SM5F.5



7 Technical Data for Specialists

The conditioner box takes care of all the aspects listed (adequate power supply; interpretation of the raw pulses). Same for the ATI, CSM, ETAS and IPETRONIK devices as mentioned in chapter 4.3, but please provide for half, not full frequency (a factor of 2 in your vane number division).

Table 6: Pin Assignment 3-Pole “Superseal”

Pin	Pin name	Explanation
1	VCC	see Table 8
2	Signal	CMOS 5 volts, 4 mA max. The signal is square and symmetric. Every rising edge and every falling edge symbolizes one vane, leading to a half frequency pulse as compared to the vane appearance frequency
3	GND	Common ground for supply and signal

Table 7: Pin Assignment M12-Thread Combination Connector 5-Pole

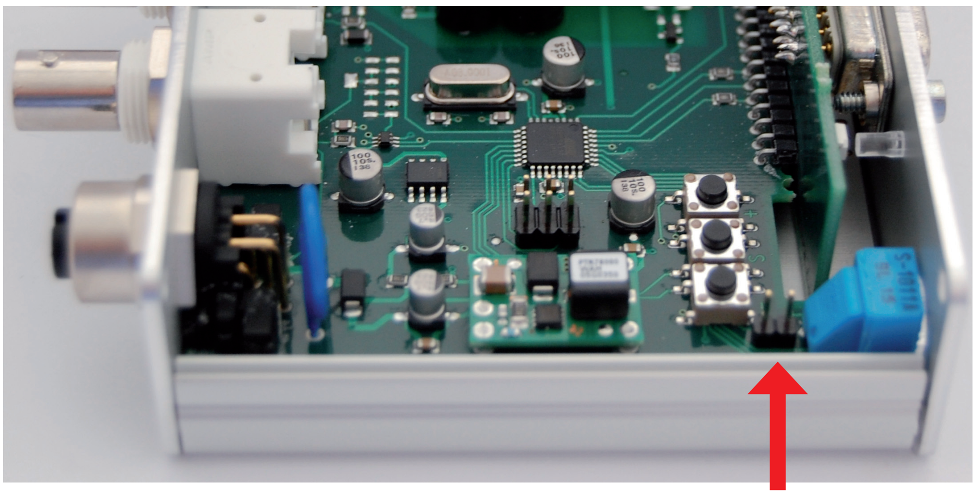
Pin	Pin name	Explanation
1	GND	This is the supply ground, connected to the aluminium box.
2	Signal-GND	Signal ground, separated from supply ground.
3	Analog-Out (Voltage)	see Table 3
4	VCC	Supply voltage 9 to 36 volts DC
5	Digital-Out (Pulses)	see Table 3

Table 8: Electrical Operating Conditions For The Sensor Element Alone

Supply voltage	+5 volts DC +/- 0.25 volts, from linear voltage regulator
Consumption	20 mA

Note: The acam conditioner box as well as the acam-independent modules mentioned in chapter 4.3 render an optimum supply voltage quality. Other supplies may be judged from standstill condition: A good low-noise power supply is necessary for a correct indication of zero speed. A more stringent specification is difficult to define and is not available at present. Generally speaking, linear voltage regulators are satisfactory, switching regulators are not.

On the front of the case there is a rotational code switch. This is to be used for setting the number of vanes. Placing an inside jumper, the range is shifted from 2 to 15 to 16 to 31. For doing this the case must be opened. The place for the jumper is shown below.



8 Change Log

07.11.2008 German original

03.02.2009 Complete revision

05.03.2009 Native speaker editing

05.09.2009 Re-layout

08.03.2010 Complete revision, release 1.1

16.10.2010 Small corrections in release 1.1

02.09.2011 Release 1.3, ATI product added

22.11.2011 Release 1.4; product list updated, tables 2 and 5 amended

03.01.2012 Section 1 (product list) corrected

The products PICOTURN-2G comply with EMC directive 89/336/EEC, applied standard DIN EN 61326, Equipment for Control and Laboratory (For use in electromagnetically controlled environment).

Generic immunity standard part 2 (EN 61000-4-4: 0,5KV, -4-6: 1V), In case of strong electro-magnetic disturbances there might be a deviation of the output signal from the specification, but only for the duration of the disturbance.

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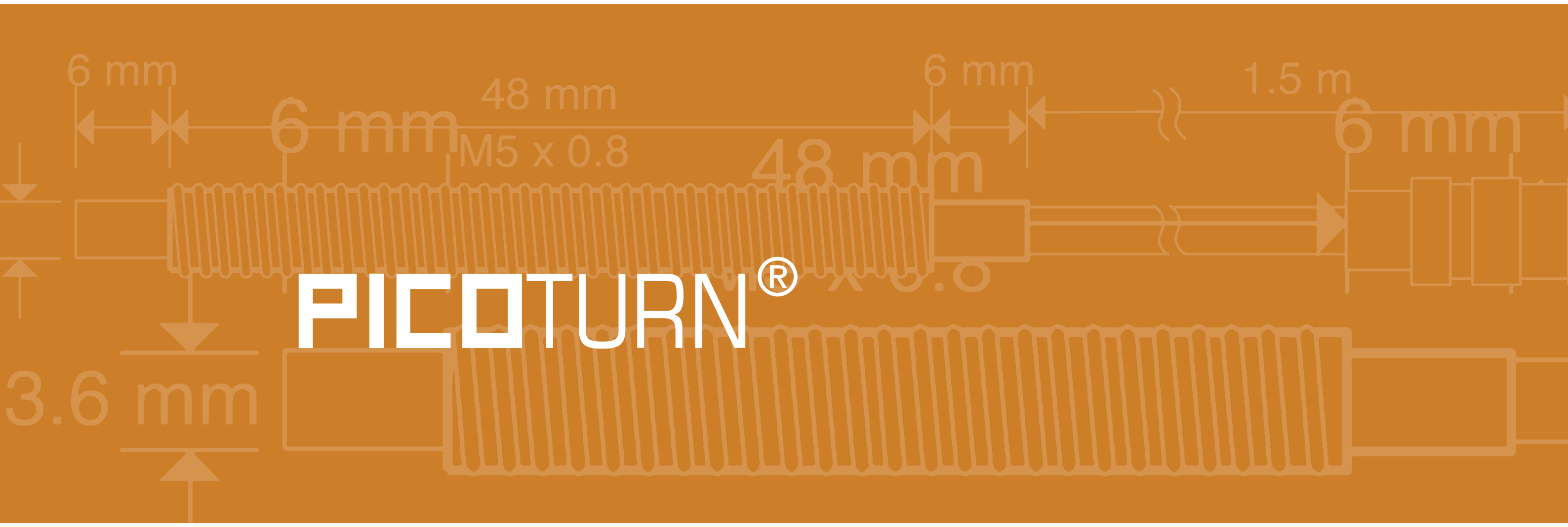

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