PICOTURN-CT

Calibration Unit for PICOTURN-BM

Manual

PICOTURN-CT

V1.0

MARCH 14TH, 2007

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Precision Time Interval Measurement

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Description

This device is for testing and calibrating the PICOTURN-BM device which is used to measure the rotational speed of turbochargers. It simulates the behavior of a sensor mounted to a turbo charger.

It is connected to the control unit PICOTURN-BM instead of a sensor. A selectable vane frequency (revolution speed) is reproduced very precisely and allows the verification and calibration of the analog and digital output signals over the entire measurement range.

The PICOTURN-BM system is designed for revolution speeds of up to 350,000 rpm. The minimum revolution speed is 200 rpm. The calibration unit PICOTURN-CT covers that entire range.

The number of vanes on a virtual compressor wheel and its simulated revolution speed are selected by push-button code switches.

- 4 to 32 vanes
- revolution speeds between 0 and 360,000 rpm in steps of 40,000 rpm

The calibration unit itself is not measuring revolution speeds and can only be operated in conjunction with a PICOTURN-BM device.

Basic Structure

The PICOTURN-CT device provides a signal output on an SMB connector, intended for being plugged to the PICOTURN-BM signal input via a coaxial cable. PICOTURN-CT is housed in an aluminum case similar to PICOTURN-BM. It is powered by a 9 to15 Volts DC power supply and can be operated in parallel with the power supply for the PICOTURN-BM device, using the banana plug sockets. The current consumption of the calibration unit alone is about 20 mA.

Dimensions
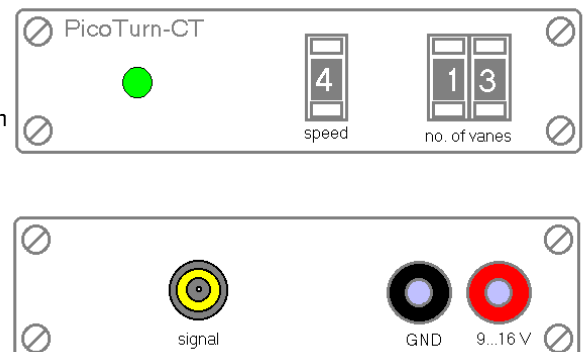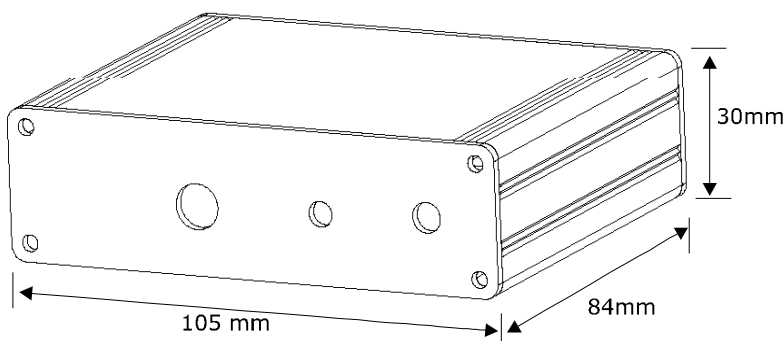
Setup

In order to get started the following steps are necessary:

- Connecting both devices to a power supply (battery, stationary power supply), connecting Vc to the red connector (labeled ‚9-15V'), GND to the black connector (labeled ‚GND'). It is possible to operate both devices in parallel with one power supply.
- Plugging the coaxial cable into the SMD connector of the PICOTURN-BM device labeled 'sensor'
- Plugging the other end of the coaxial cable into the SMD connector of the calibration device labeled 'signal'
- Selecting the correct number of vanes at the rotational code switch of the PICOTURN-BM device.
- Selecting the same number of vanes with the push-button code switches of the calibration device (choose a value between 04 and 32).
- Connecting the digital and/or analog output connectors to a an oscilloscope or voltmeter.
- Selecting the desired rotational speed at the push-button code switch labeled "speed".

A red-colored light-emitting diode displays PICOTURN-BM's operating status, which deserves to be recorded. Before plugging the coaxial, this LED should "flicker". After plugging, with "speed" set to zero, it should turn dark. On toggling to a non-zero speed, it should give continuous light.

Settings

- The push-button code switch labeled "speed" on the calibration device sets the revolution speed. The simulated speed is given by the number shown on the switch times 40,000 rpm. A switch position of "0" means no rotation, "1" a revolution speed of 40 thousand rounds per minute, "2" means 80,000 rpm, and so on up to "9", which represents 360,000 rpm.
- A double push-button code switch permits to choose the "number of vanes" present on the virtual turbolader compressor wheel, to be simulated.

Please note that the maximum vane frequency (vanes per second) is 100 kHz. Is this frequency exceeded due to "speed" and "no. of vanes" setting, the calibration device automatically goes back to standstill. Choosing parameters out of range (e.g. no. of vanes < 4 or > 32) provokes standstill simulation, too.

If the control device PICOTURN-BM detects no rotation, it goes into a wait mode and the voltage at the analog output connector measures 0,5 V. The red LED is off.

The following table gives an overview over all valid settings for revolution speed and no. of vanes with the resulting vane frequency in kHz (thousands of vanes per second).

Table 1 : Vane frequency = f(revolution speed, no. of vanes)

SZ	\"Speed\"-Schalter									
	0	1	2	3	4	5	6	7	8	9
04	0,0	2,667	5,333	8,000	10,667	13,333	16,000	18,665	21,333	23,995
05	0,0	3,333	6,667	10,000	13,333	16,667	20,000	23,337	26,667	30,008
06	0,0	4,000	8,000	12,001	16,000	20,000	23,995	27,992	32,000	36,004
07	0,0	4,667	9,333	14,001	18,665	23,337	27,992	32,680	37,348	42,017
08	0,0	5,333	10,667	16,000	21,333	26,667	32,000	37,348	42,644	48,019
09	0,0	6,000	12,001	18,002	23,995	30,008	36,004	42,017	48,019	53,981
10	0,0	6,667	13,333	20,000	26,667	33,333	40,000	46,674	53,333	59,970
11	0,0	7,333	14,668	22,002	29,326	36,664	44,004	51,348	58,651	66,007
12	0,0	8,000	16,000	23,995	32,000	40,000	48,019	56,022	64,000	71,942
13	0,0	8,667	17,331	26,008	34,662	43,337	52,016	60,698	69,324	77,973
14	0,0	9,333	18,665	27,992	37,348	46,674	56,022	65,359	74,627	84,034
15	0,0	10,000	20,000	30,008	40,000	50,000	59,970	70,053	80,000	90,090
16	0,0	10,667	21,333	32,000	42,644	53,333	64,000	74,627	85,288	95,923
17	0,0	11,335	22,663	34,014	45,351	56,657	68,027	79,365	90,703	0,000
18	0,0	12,001	23,995	36,004	48,019	59,970	71,942	84,034	95,923	0,000
19	0,0	12,666	25,332	37,987	50,697	63,291	76,046	88,692	0,000	0,000
20	0,0	13,333	26,667	40,000	53,333	66,667	80,000	93,240	0,000	0,000
21	0,0	14,001	27,992	42,017	56,022	70,053	84,034	98,039	0,000	0,000
22	0,0	14,668	29,326	44,004	58,651	73,394	87,912	0,000	0,000	0,000
23	0,0	15,332	30,675	45,977	61,350	76,628	91,954	0,000	0,000	0,000
24	0,0	16,000	32,000	48,019	64,000	80,000	95,923	0,000	0,000	0,000
25	0,0	16,667	33,333	50,000	66,667	83,333	100,000	0,000	0,000	0,000
26	0,0	17,331	34,662	52,016	69,324	86,580	0,000	0,000	0,000	0,000
27	0,0	18,002	36,004	53,981	71,942	90,090	0,000	0,000	0,000	0,000
28	0,0	18,665	37,348	56,022	74,627	93,240	0,000	0,000	0,000	0,000
29	0,0	19,333	38,685	57,971	77,369	96,618	0,000	0,000	0,000	0,000
30	0,0	20,000	40,000	59,970	80,000	100,000	0,000	0,000	0,000	0,000
31	0,0	20,672	41,322	62,016	82,645	0,000	0,000	0,000	0,000	0,000
32	0,0	21,333	42,644	64,000	85,288	0,000	0,000	0,000	0,000	0,000

Note: The ideal frequency values would all be multiples of 0.3333333 kHz. The reason why some are not is that they are all derived from a single oscillator frequency, with divisors sometimes odd. There is no adverse incidence on the calibration of the analog output voltage.

Interpretation Of Results: The Digital Output

Table 1 shows an overview of the vane frequencies. At the digital output of the **PICO**TURN-BM device, however, the frequency is different. It is that frequency divided by the number of vanes selected on the **PICO**TURN-BM device switch. If the number of vanes settings are identical on both devices, as recommended, the frequency at the digital output of **PICO**TURN-BM will have approximately the following values (as approximate target values):

SZ	\"Speed\"-Schalter									
	0	1	2	3	4	5	6	7	8	9
04 bis 16	0,0	0,667	1,333	2,000	2,667	3,333	4,000	4,667	5,333	6,000
17 bis 32	0,0	0,667	1,333	2,000	2,667	wie oben oder 0,0				

Table 2: Approximate target values of the digital display in kHz
Accurate values can be determined by dividing the table 1 values by the number of vanes setting. Regarding the speed settings '8' and '9' see also section "Extreme Speed" in this document.

Interpretation Of Results: The Analog Output

The analog output of the control device **PICO**TURN-BM is a 0.5V – 4.5V interface. The slope of the output signal versus the vane frequency is 80,000 rpm/V which means that the voltage is 4.5V at 320,000 rpm. Please note that the no. of vanes selected at the control device **PICO**TURN-BM influences the voltage at its analog output. The slope of 80,000 rpm/V is only valid for the correct selection of no. of vanes.

Therefore it is important that the no. of vanes selected at the control device **PICO**TURN-BM is equal to the no. of vanes selected at the calibration device.

By changing the revolution speed on the calibration device the stepwise change of the output voltage on the control device **PICO**TURN-BM can be observed. At the starting position with no rotation the voltage is 0.5V. With each increase of the revolution speed by one the output voltage increases by 0.5V up to 5V at a revolution speed of 360,000 rpm.

This stepwise change of the output voltage can be observed at each no. of vanes selected within the valid range.

Please note that when using the analog output the selected no. of vanes has to be between 4 and 31..

The following table shows an overview over the target values of the analog output voltage of the control device **PICO**TURN-BM for all settings of revolution speed and no. of vanes at the calibration device.

SZ	"Speed"-Schalter									
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
00 bis 03	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5
04 bis 16	0,500	1,000	1,500	2,000	2,500	3,000	3,500	4,000	4,500	5,000
17 und 18	0,500	1,000	1,500	2,000	2,500	3,000	3,500	4,000	4,500	0,5
19 bis 21	0,500	1,000	1,500	2,000	2,500	3,000	3,500	4,000	0,5	0,5
22 bis 25	0,500	1,000	1,500	2,000	2,500	3,000	3,500	0,5	0,5	0,5
26 bis 30	0,500	1,000	1,500	2,000	2,500	3,000	0,5	0,5	0,5	0,5
31	0,500	1,000	1,500	2,000	2,500	0,5	0,5	0,5	0,5	0,5

Table 3: Target values of the analog output in volts
Note: The electronics is unable to reach 5,00 volts and will display approx. 4,95 volts instead.

The actual values will be slightly different from the target values since they are generated by a digital-to-analog converter. Variations of plus/minus15 mV are unavoidable even with optimal adjustment.

Interpretation Of Results: Extreme Speed

On original, "ex works" tuning, **PICO**TURN-BM is limited to 50 thousand vanes per second. In terms of **PICO**TURN-CT settings, this corresponds to "speed" = "7" and "no. of vanes" = "10" and thus 280 thousand r.p.m. In order to measure higher speed, you must modify the **PICO**TURN-BM tuning, see dedicated manual.

Special Mode: Idle Speed

In order to simulate an idle state of the engine, put "no. of vanes" to "01" and "speed" to "1". This results in simulating 666 vanes per second. Accordingly, pulses are detected at the digital output, which depend on setting made to **PICO**TURN-BM. When setting is "0", frequency will be 666 Hz, when set to "5" it will be 133 Hz, when set to "10", it will be 67 Hz and so forth. – This operating mode is intended for test only and does not serve calibration purposes.

Order Codes

Electronic Devices

Type	No.	Description
PICOTURN-BM V5.5	MNR 1160	Controller 8 - 30 V
PICOTURN-CT	MNR 890	Calibration device for controller units
PICOTURN-DY	MNR 1155	Display unit

Sensors

PICOTURN-SM5.1	MNR 586	Sensor M5
PICOTURN-SM5.2	MNR 607	Sensor M5, reduced head
PICOTURN-SM5.3	MNR 933	Sensor M5, High temperature
PICOTURN-SM5.5	MNR 998	Sensor M5, High temperature
PICOTURN-SM5.5L	MNR 1108	Sensor M5, High temperature
PICOTURN-SM5.6	MNR 1059	Sensor M5, High temperature
PICOTURN-SM5.7	MNR 1065	Sensor M5, High temperature
PICOTURN-SM5F.2	MNR 934	Sensor M5 fine, High temperature
PICOTURN-SM5F.3	MNR 1081	Sensor M5 fine, High temperature

Accessories

Clamping nut	MNR 696	Fine thread nut for ..-SM5F.x sensors
Extension cable	MNR 594	1,5m extension cable sensor, (SMB-SMB)
Extension cable (*)	MNR 707	2,5m extension cable sensor, (SMB-SMB)

(*) not suitable for "L"-type sensors (with extra long cables)

Serial Number

SN aaaa.bbbbbb.ccc   a = Material code, b = Date code YYMMDD, c = individual

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The products PICOTURN-BM and PICOTURN-CT with its components 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 electromagnetic disturbances there might be a deviation of the ouput signal from the specification, but only for the duration of the disturbance.