HD 778TR1 - HD 978TR1
HD 778-TCAL - HD 978TR2

4÷20mA CONFIGURABLE TEMPERATURE TRANSMITTERS FOR K-J-T-N TYPE THERMOCOUPLE THERMOCOUPLE GENERATOR MANAGED BY PC THROUGH RS232C HD778-TCAL

HD 778TR1, HD 978TR1 and HD 978TR2 are 4…20mA two-wired passive transmitters with a microprocessor. These can be configured for thermocouple sensors type **K, J, T** and **N**. They convert the voltage value generated by the thermocouple into an electric linear signal within the 4…20mA range. The use of digital devices obtains excellent precision and stability in time. The user can set the 4…20mA (or 20…4mA) output in any temperature range included in the measurement range of the individual thermocouples with a **minimum range of 50 °C**. The range and type of thermocouple are simply set by using one button. A led signals the alarm situation (out of order or unconnected sensor) and helps the user during the programming phases. The transmitters are also protected against polarity inversion. HD778TR1 is specifically designed to be installed on DIN B connection heads; HD978TR1 and HD978TR2 are suitable for mounting on 35 mm DIN bars. In addition to the 4…20mA output, HD978TR2 has a 3½ digit display (height 10 mm) that allows the measured temperature to be displayed.

Technical information @ 25°C and 24Vdc

INPUT	**HD778TR1**	**HD978TR1**	**HD978TR2**
Sensor	Type of thermocouple: K, J, T and N		
Connection	Two-wired passive transmitter		
Measurement range	Thermocouple K: -200°C … +1200°C Thermocouple J: -200°C … +800°C Thermocouple T: -200°C … +300°C Thermocouple N: -200°C … +1200°C		
Linearization	EN 60584-1-2 ASTM E 230 - ANSI (MC96-1)		
Default range	Tc = K - Range = 0...1000°C		
Minimum measurement range	50°C		
Speed of conversion	2 measurements per second		
Precision	±0,04%FS±0,04% of the reading or 0.5°C (the greater of the two values)		
Cold coupling temperature range	-30 … +80°C	0 … +70°C	
Functioning temperature	-30 … +80°C	0 … +70°C	
Storage temperature	-40 … +80°C		
OUTPUT			
Type of output (note 1)	4...20 mA (or 20...4 mA) two-wired 22 mA, in case of out of order or unconnected sensor		
Resolution	4 µA		4 µA Display: 0.1°C T<200°C 1°C T>200°C
Power voltage	9...30V dc (protection against polarity inversion)		
Sensitivity to Vdc power voltage variations	0.4 µA/V		
Load resistance	R_LMax = (Vdc-9)/0.022 R_LMax = 625Ω with Vdc = 24 Vdc		
Input/output galvanic insulation	50Vdc (checked at 250V)		
Red led	Turns on during the programming phase if the thermocouple is out of order or unconnected.		
Warm-up time	2 minutes		

Note 1) If the measured temperature T goes out of the T1...T2 (T1<T2) set range, the transmitters linearly regulate the current for T<T1 and T>T2 for an interval of 10°C. (See the current diagram.)

INSTALLATION AND CONNECTION

Fig. 1 shows the mechanical dimensions of the HD778TR1 transmitter and shows the 5 mm holes for DIN head locking and the central hole for the thermocouple wires input. Fig. 1 also reports the mechanical dimensions of HD978TR1 and HD978TR2.

HD978TR1 width is a DIN module (17.5 mm), HD978TR2 2 DIN modules (35 mm). The working temperature must be included in the defined range of function. Fig. 4 and 5 report the HD778TR1, HD978TR1 and HD978TR2 connection schemes. In order to obtain the maximum precision, the connection to the thermocouple should not exceed 3 meters in length. In the diagrams attached, the RL (Load) symbol represents any device inserted in the current loop, that is to say, an indicator, a controller, a data logger or a register.

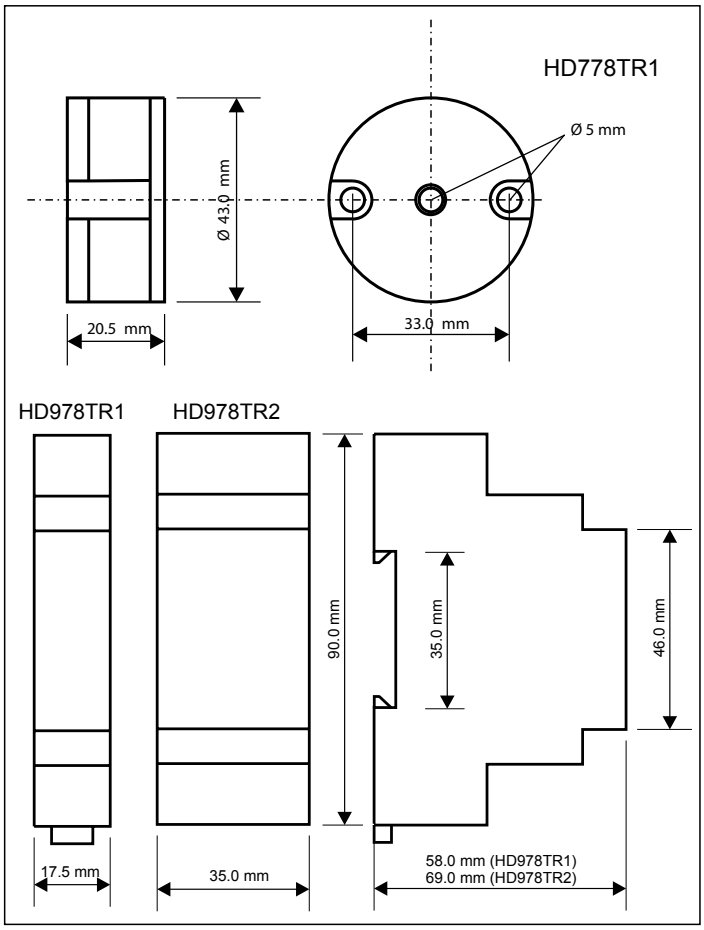


Fig.1 Mechanical dimensions.

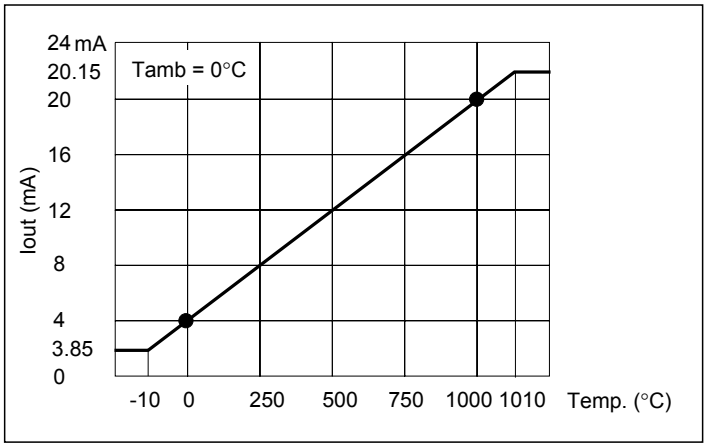


Fig.2 Range 0…1000°C, current output with relation to temperature.

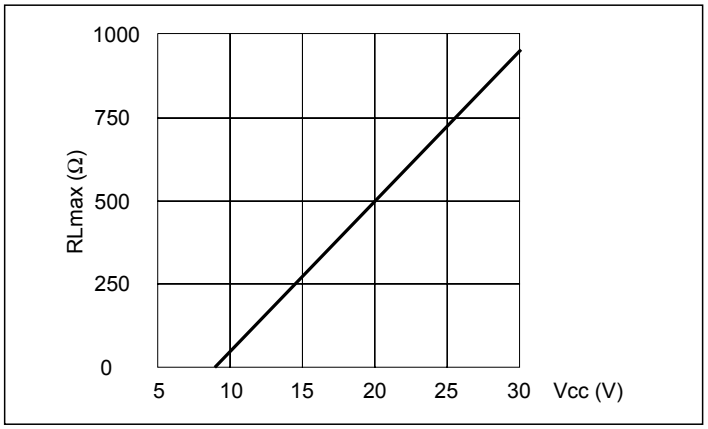


Fig.3 Load resistance with relation to temperature.

CHOOSING THE TYPE OF THERMOCOUPLE

The transmitter accepts four types of thermocouples. The set thermocouple is indicated by the number of led blinks when the power is turned on.

Number of led blinks	Type of thermocouple
1	K
2	J
3	T
4	N

The transmitters are supplied with the default setting of: K thermocouple and 4…20mA = 0…1000°C range.

The user can modify the type of thermocouple and the range of functioning with the following procedures.

Note: after modifying the type of thermocouple, the range of functioning must be programmed.

HD778TR1 and HD978TR1

When turning on the transmitter, the led blinks for a certain number of times equal to the type of thermocouple previously set.

In order to modify the setting, turn the transmitter off and back on again **keeping the button pressed down.**

This opens the program for selecting the type of thermocouple. If the **K thermocouple** has been selected the led blinks once.

If you release the button and press it down again within 10 seconds, the led will blink twice: the **J thermocouple** is now selected.

If you press the button again within 10 seconds, the led will blink 3 times: the **T thermocouple** is now selected.

If you press the button again within 10 seconds, the led will blink 4 times: the **N thermocouple** is now selected.

If you press again the button within 10 seconds, the led will blink once to indicate that the K thermocouple has been selected again and the cycle repeats.

In order to save the selected thermocouple, do not press the button and wait 15 seconds. As the transmitter saves the type of thermocouple, the led blinks for a number of times equal to the type of thermocouple selected.

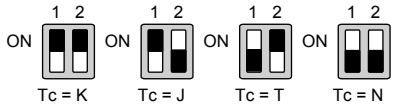
If you modified the type of thermocouple the range of functioning must be reprogrammed. See the paragraph entitled "PROGRAMMING THE RANGE OF FUNCTIONING".

HD978TR2

This transmitter is fitted with a dual dip-switch for the selection of the thermocouple type. The selection must be made before turning it on and it is set when the device is turned on: a dip-switch change does not produce any effect when the device is powered on until the next time it is turned off and on.

Procedure:

With the device turned off, select the type of thermocouple by setting the switches as shown in the following figure.



When powering the transmitter, the led blinks for a number of times equal to the type of thermocouple previously set.

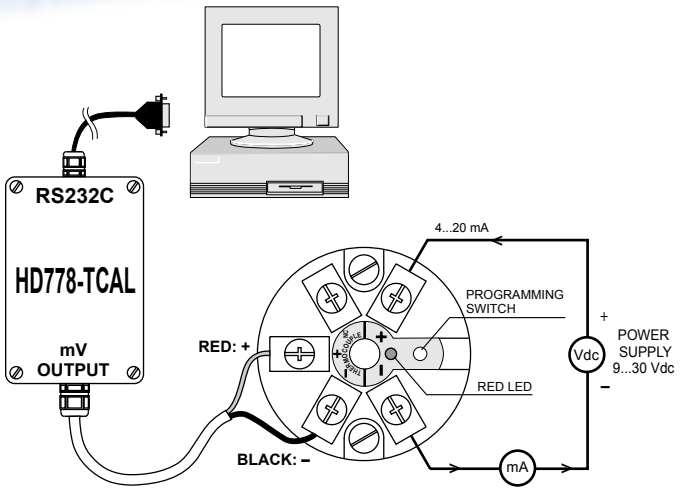
If you modified the type of thermocouple the range of functioning must be reprogrammed. See the paragraph entitled "PROGRAMMING THE RANGE OF FUNCTIONING".

PROGRAMMING THE RANGE OF FUNCTIONING.

The HD778TR1, HD978TR1 and HD978TR2 transmitters are supplied with a default setting of: K thermocouple and 0...1000°C range. The user can set a different range according to his requirements with a minimum span of 50°C. The correspondence between the read temperature and the output current can be direct (e.g. 4mA = 0°C and 20mA = 1000°C) or inverse (e.g. 4mA = 1000°C and 20mA = 0°C).

Avail yourself of the following programming tools:

- 9…30 Vdc direct current power source,
- Thermocouple gauge,
- Copper connection cables,
- Precision ammeter with 0...25 mA minimum range.



In place of the thermocouple gauge, it is possible to use the **HD778-TCAL** Delta Ohm. This device must be connected to the PC's serial port, and by using the special software it automates all the steps described below for the programmed range of functioning.

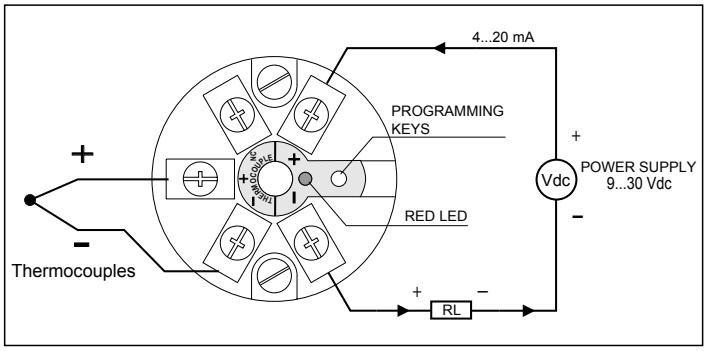


Fig.4 Connection diagram of HD778TR1.

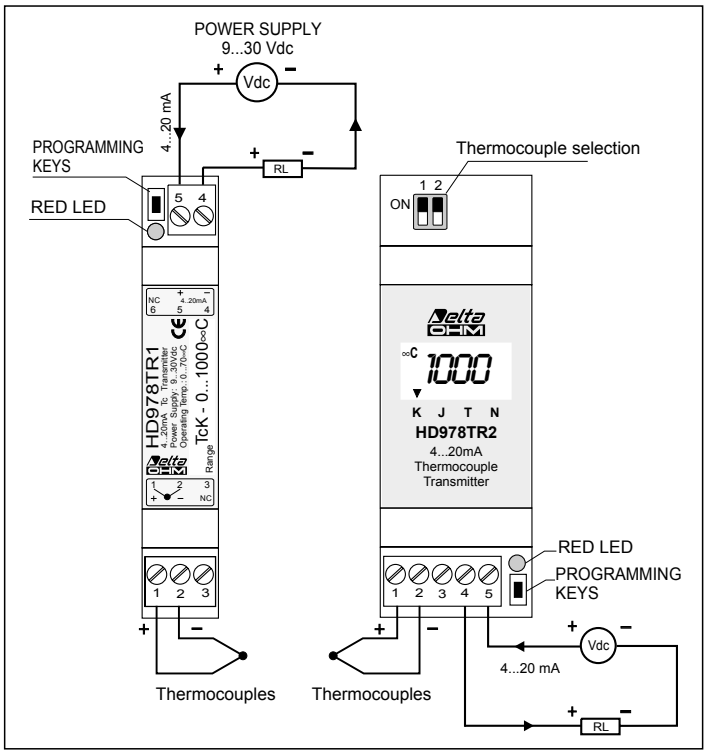


Fig.5 Connection diagram of HD978TR1 and HD978TR2

If you have a thermocouple gauge then the steps are as follows:
To set the type of thermocouple proceed as described in the "CHOOSING THE TYPE OF THERMOCOUPLE" paragraph.

The voltage values generated by the gauge must not be balanced.

The set up process must be carried out with the device already turned on.

Set up the gauge for the desired type of thermocouple (K, J, T o N); connect the gauge to the transmitter's thermocouple input, according to its polarity. (**Pay attention to the polarity.)**

Set the gauge so that it generates the voltage corresponding to the temperature at 4mA, and wait 30 seconds until the voltage stabilizes. The table Tab. 1 reports the voltages generate by the HD778-TCAL gauge according to the type of thermocouple corresponding to the temperature value.

Press and keep the button pressed until the led starts blinking. Release the button. The device acquires the first value of the transmitter work range, and the led continues blinking. The tool now waits for the second data of the end of scale range.

Set the gauge so that it generates the voltage corresponding to the temperature at 20mA.

Press and keep the button pressed until the led stops blinking.

Release the button and wait 20 seconds, **without modifying the gauge data,** so that the transmitter memorizes the calibration data and is ready to function normally. The operation is complete when the led blinks once.

The device has acquired the second point corresponding to the range you wish to configure and starts to function normally.

The minimum span value accepted by the device is 50°C. If, after entering the first value T1 of the range, the user tries to enter a second value T2 with (T2-T1)<50, the device does not accept it and remains in the waiting status with the led continuing to blink.

HD778-TCAL is provided with its own software. After it is connected to a PC serial port by the programmer, the operator can follow the instructions on the screen to configure the transmitter.

ORDER CODES

HD778TR1: 4…20mA/20…4mA 2 wire temperature transmitter for K, J, T and N thermocouples, configurable with minimum amplitude range 50°C, in a container for DIN B 43760 heads.

HD978TR1: 4…20mA/20…4mA 2 wire temperature transmitter for K, J, T and N thermocouples, configurable with minimum amplitude range 50°C, in a container for 35 mm DIN bar connection, dimension 1 module.

HD978TR2: 4…20mA/20…4mA 2 wire temperature transmitter for K, J, T and N thermocouples, configurable with minimum amplitude range 50°C, in a container for 35 mm DIN bar connection dimension 2 modules, with 3½ digit display, height 10 mm.

HD778-TCAL: power generator in the range -60mV…+60mV, regulated by PC through RS232C serial port, DELTALOG7 software for setting K, J, T and N thermocouple transmitters.

Tab.1 - Voltage generated by a thermocouple with relation to the temperature (°C), by thermocouples type K, J, T and N in accordance with the standards EN 60584-1-2 ASTM E 230 - ANSI (MC96.1). Reference joint and 0°C.

Tc K (Ref @ 0°C)

°C	mV	°C	mV
-200	-5.891	510	21.071
-190	-5.730	520	21.497
-180	-5.550	530	21.924
-170	-5.354	540	22.350
-160	-5.141	550	22.776
-150	-4.913	560	23.203
-140	-4.669	570	23.629
-130	-4.411	580	24.055
-120	-4.138	590	24.480
-110	-3.852	600	24.905
-100	-3.554	610	25.330
-90	-3.243	620	25.755
-80	-2.920	630	26.179
-70	-2.587	640	26.602
-60	-2.243	650	27.025
-50	-1.889	660	27.447
-40	-1.527	670	27.869
-30	-1.156	680	28.289
-20	-0.778	690	28.710
-10	-0.392	700	29.129
0	0.000	710	29.548
10	0.397	720	29.965
20	0.798	730	30.382
30	1.203	740	30.798
40	1.612	750	31.213
50	2.023	760	31.628
60	2.436	770	32.041
70	2.851	780	32.453
80	3.267	790	32.865
90	3.682	800	33.275
100	4.096	810	33.685
110	4.509	820	34.093
120	4.920	830	34.501
130	5.328	840	34.908
140	5.735	850	35.313
150	6.138	860	35.718
160	6.540	870	36.121
170	6.941	880	36.524
180	7.340	890	36.925
190	7.739	900	37.326
200	8.138	910	37.725
210	8.539	920	38.124
220	8.940	930	38.522
230	9.343	940	38.918
240	9.747	950	39.314
250	10.153	960	39.708
260	10.561	970	40.101
270	10.971	980	40.494
280	11.382	990	40.885
290	11.795	1000	41.276
300	12.209	1010	41.665
310	12.624	1020	42.053
320	13.040	1030	42.440
330	13.457	1040	42.826
340	13.874	1050	43.211
350	14.293	1060	43.595
360	14.713	1070	43.978
370	15.133	1080	44.359
380	15.554	1090	44.740
390	15.975	1100	45.119
400	16.397	1110	45.497
410	16.820	1120	45.873
420	17.243	1130	46.249
430	17.667	1140	46.623
440	18.091	1150	46.995
450	18.516	1160	47.367
460	18.941	1170	47.737
470	19.366	1180	48.105
480	19.792	1190	48.473
490	20.218	1200	48.838
500	20.644		

Tc J (Ref @ 0°C)

°C	mV	°C	mV
-200	-5.891	510	21.071
-190	-5.730	520	21.497
-180	-5.550	530	21.924
-170	-5.354	540	22.350
-160	-5.141	550	22.776
-150	-4.913	560	23.203
-140	-4.669	570	23.629
-130	-4.411	580	24.055
-120	-4.138	590	24.480
-110	-3.852	600	24.905
-100	-3.554	610	25.330
-90	-3.243	620	25.755
-80	-2.920	630	26.179
-70	-2.587	640	26.602
-60	-2.243	650	27.025
-50	-1.889	660	27.447
-40	-1.527	670	27.869
-30	-1.156	680	28.289
-20	-0.778	690	28.710
-10	-0.392	700	29.129
0	0.000	710	29.548
10	0.397	720	29.965
20	0.798	730	30.382
30	1.203	740	30.798
40	1.612	750	31.213
50	2.023	760	31.628
60	2.436	770	32.041
70	2.851	780	32.453
80	3.267	790	32.865
90	3.682	800	33.275
100	4.096	810	33.685
110	4.509	820	34.093
120	4.920	830	34.501
130	5.328	840	34.908
140	5.735	850	35.313
150	6.138	860	35.718
160	6.540	870	36.121
170	6.941	880	36.524
180	7.340	890	36.925
190	7.739	900	37.326
200	8.138	910	37.725
210	8.539	920	38.124
220	8.940	930	38.522
230	9.343	940	38.918
240	9.747	950	39.314
250	10.153	960	39.708
260	10.561	970	40.101
270	10.971	980	40.494
280	11.382	990	40.885
290	11.795	1000	41.276
300	12.209	1010	41.665
310	12.624	1020	42.053
320	13.040	1030	42.440
330	13.457	1040	42.826
340	13.874	1050	43.211
350	14.293	1060	43.595
360	14.713	1070	43.978
370	15.133	1080	44.359
380	15.554	1090	44.740
390	15.975	1100	45.119
400	16.397	1110	45.497
410	16.820	1120	45.873
420	17.243	1130	46.249
430	17.667	1140	46.623
440	18.091	1150	46.995
450	18.516	1160	47.367
460	18.941	1170	47.737
470	19.366	1180	48.105
480	19.792	1190	48.473
490	20.218	1200	48.838
500	20.644		

Tc T (Ref @ 0°C)

°C	mV
-200	-5.603
-190	-5.439
-180	-5.261
-170	-5.070
-160	-4.865
-150	-4.648
-140	-4.419
-130	-4.177
-120	-3.923
-110	-3.657
-100	-3.379
-90	-3.089
-80	-2.788
-70	-2.476
-60	-2.153
-50	-1.819
-40	-1.475
-30	-1.121
-20	-0.757
-10	-0.383
0	0.000
10	0.391
20	0.790
30	1.196
40	1.612
50	2.036
60	2.468
70	2.909
80	3.358
90	3.814
100	4.279
110	4.750
120	5.228
130	5.714
140	6.206
150	6.704
160	7.209
170	7.720
180	8.237
190	8.759
200	9.288
210	9.822
220	10.362
230	10.907
240	11.458
250	12.013
260	12.574
270	13.139
280	13.709
290	14.283
300	14.862

Tc N (Ref @ 0°C)

°C	mV	°C	mV
-200	-3.990	510	17.131
-190	-3.884	520	17.515
-180	-3.766	530	17.900
-170	-3.634	540	18.286
-160	-3.491	550	18.672
-150	-3.336	560	19.059
-140	-3.171	570	19.447
-130	-2.994	580	19.835
-120	-2.808	590	20.224
-110	-2.612	600	20.613
-100	-2.407	610	21.003
-90	-2.193	620	21.393
-80	-1.972	630	21.784
-70	-1.744	640	22.175
-60	-1.509	650	22.566
-50	-1.269	660	22.958
-40	-1.023	670	23.350
-30	-0.772	680	23.742
-20	-0.518	690	24.134
-10	-0.260	700	24.527
0	0.000	710	24.919
10	0.261	720	25.312
20	0.525	730	25.705
30	0.793	740	26.098
40	1.065	750	26.491
50	1.340	760	26.883
60	1.619	770	27.276
70	1.902	780	27.669
80	2.189	790	28.062
90	2.480	800	28.455
100	2.774	810	28.847
110	3.072	820	29.239
120	3.374	830	29.632
130	3.680	840	30.024
140	3.989	850	30.416
150	4.302	860	30.807
160	4.618	870	31.199
170	4.937	880	31.590
180	5.259	890	31.981
190	5.585	900	32.371
200	5.913	910	32.761
210	6.245	920	33.151
220	6.579	930	33.541
230	6.916	940	33.930
240	7.255	950	34.319
250	7.597	960	34.707
260	7.941	970	35.095
270	8.288	980	35.482
280	8.637	990	35.869
290	8.988	1000	36.256
300	9.341	1010	36.641
310	9.696	1020	37.027
320	10.054	1030	37.411
330	10.413	1040	37.795
340	10.774	1050	38.179
350	11.136	1060	38.562
360	11.501	1070	38.944
370	11.867	1080	39.326
380	12.234	1090	39.706
390	12.603	1100	40.087
400	12.974	1110	40.466
410	13.346	1120	40.845
420	13.719	1130	41.223
430	14.094	1140	41.600
440	14.469	1150	41.976
450	14.846	1160	42.352
460	15.225	1170	42.727
470	15.604	1180	43.101
480	15.984	1190	43.474
490	16.366	1200	43.846
500	16.748		