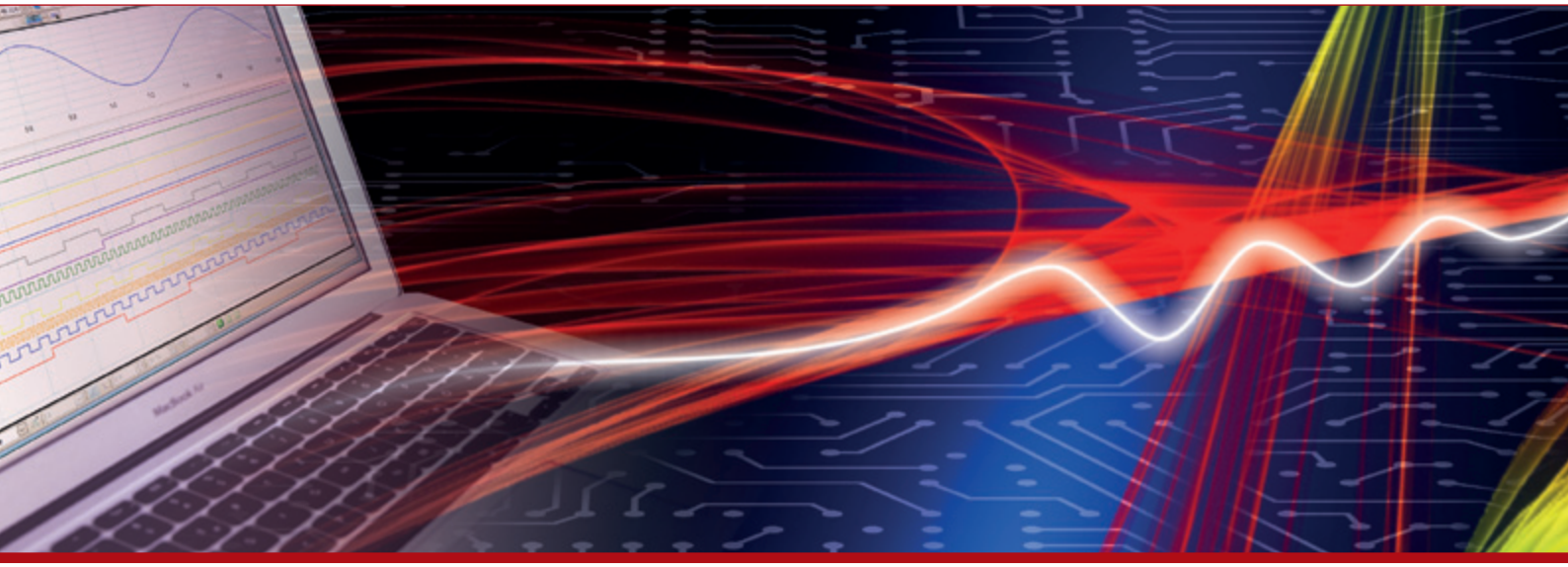
Product Datasheet - Technical Specifications



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OPEN GTEM CELL FOR EMC PRE-COMPLIANCE TESTING

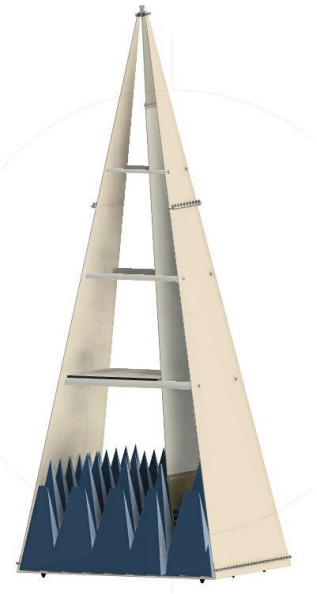
1 Introduction

The TBGTC1 open GTEM-cell adds to our existing portfolio of low-cost open TEM-cells for EMC pre-compliance testing. Unlike TEM cells, which have limits at higher frequencies, GTEM cells may operate up to many GHz.

Products can be examined for radiated emissions and immunity before and after EMC-related design changes using a spectrum analyzer with tracking generator, modulated power amplifier, and EMCview software.

The engineer can easily validate whether his changes improved or harmed the EMC performance, or if it stayed unaltered. The use of GTEM cells eliminates the need for guesswork.

When positioned vertically, the TBGTC1 requires just an area of 78 cm × 52 cm. The EUT can be conveniently placed on a supplied wooden board that rests on the GTEM-cell spacers.



2 GTEM cell

A GTEM cell is a tapered, hybrid terminated 50 ohm stripline device for radiated emissions and immunity testing of electronic devices. It is not a replacement, but due to its size and cost it is a convenient alternative to measurements in an anechoic chamber.

A GTEM cell consists of a septum, the conductive strip in the centre section and walls which are connected to ground. The geometry is designed to present a 50Ω stripline. The device under test (DUT) is placed in between the bottom wall and the septum.

The TBGTC1 is an “open GTEM cell” with no side walls for convenient placement of the DUT and a preferable vertical configuration. It may pick up RF background noise, which however can be taken into account by doing a measurement of the cell output signal before powering on the DUT or by placing the GTEM-cell in a shielded tent, which is also available from Tekbox.

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3 Technical data

GTEM Cell TBGTC1

Septum Height: 250 mm at the location of the EUT-board

Outer dimensions (LxWxH): 1452x780x520 mm

Approx Cell Weight: 13 kg.

Maximum EUT size (LxWxH): 200x200x150 mm

Defined test volume (±3 dB < 3000 MHz, LxWxH): 100x100x100 mm

GTEM cell connectors: N-female

Nominal cell impedance: 50 Ohm

Frequency range: 0.009 MHz – 6 GHz

Wave impedance: 377 Ohm

Maximum continuous RF input power: 600W

VSWR: 1:1.3 typical, 1:1.9 max.

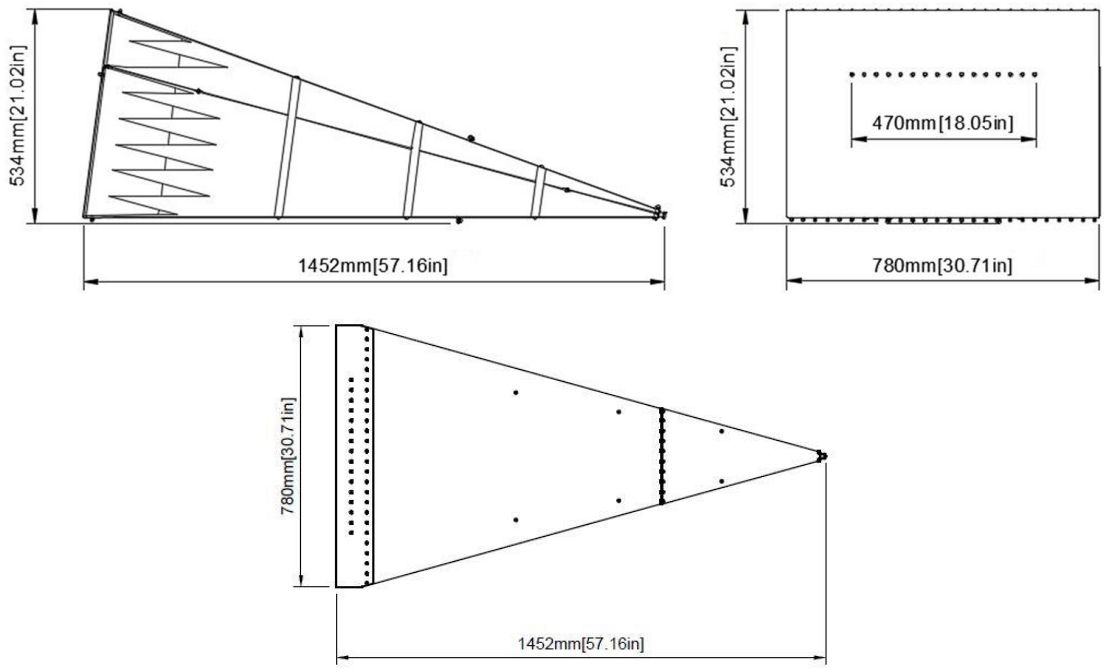
Field uniformity on maximum test volume: up to 3 GHz < ± 6 dB

Optional shielded tent TBST-100/100/200:

Construction: two layers of conductive silver fabrics, access opening with conductive Velcro, aluminium frame

Ambient noise suppression: up to 50 dB in the range 10 MHz to 6 GHz

Dimensions:



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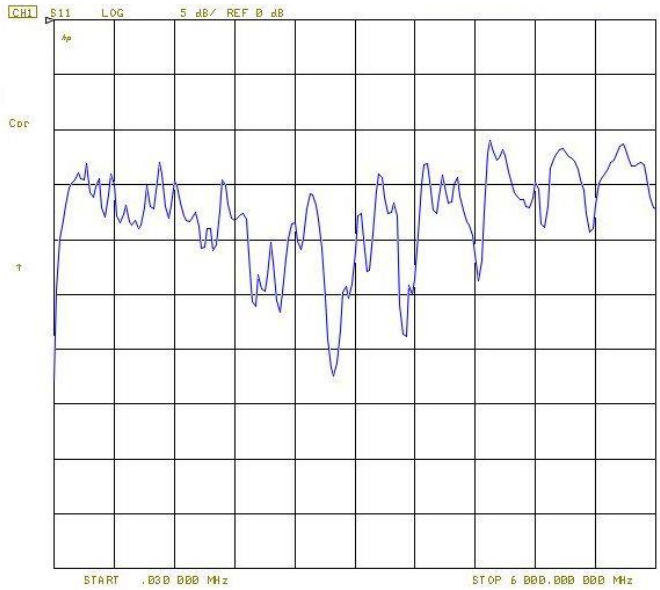
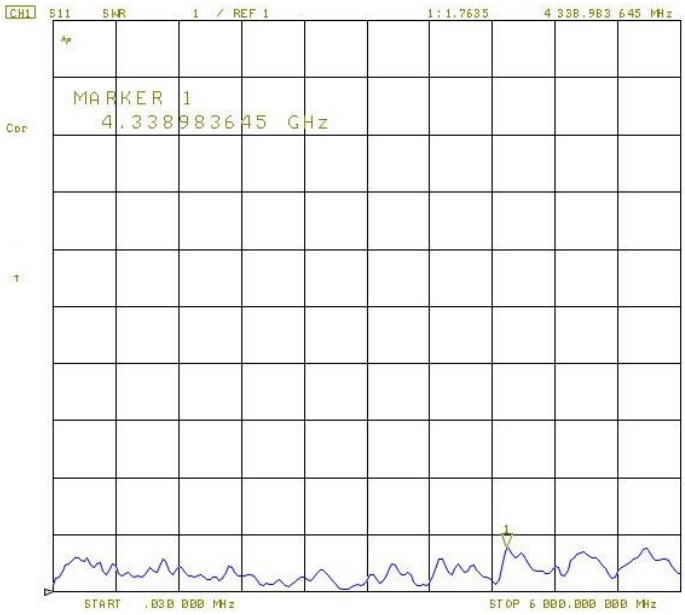
Input return loss:



TBGT1, input return loss, 30 kHz – 6 GHz

VSWR:



TBGT1, VSWR, 30 kHz – 6 GHz

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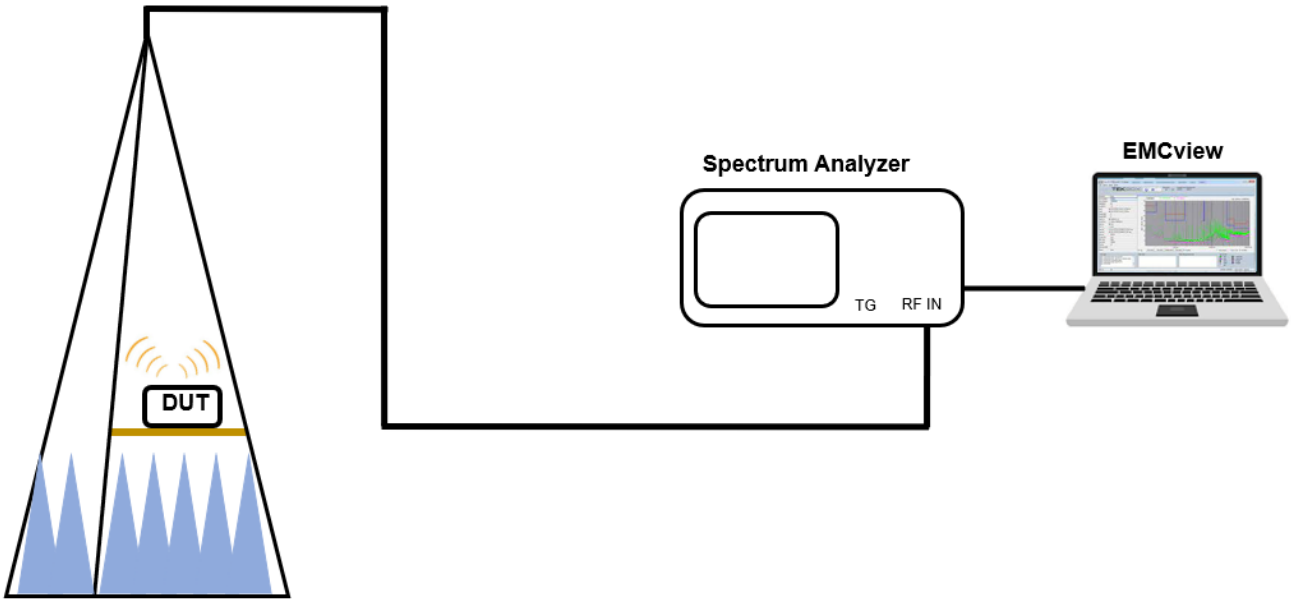
4 Application

4.1 Radiated emission tests:

The septum of the GTEM-cell, similar to a broadband antenna, picks up radiated noise from the EUT and presents it to the spectrum analyzer or a receiver input.



radiated emission measurement using the TBGTC1 GTEM-cell a spectrum analyzer and EMCview

It should be noted that radiated emission measurements in a GTEM-cell are near-field measurements. The spectrum analyzer displays the result in dBµV, but the relevant standards specify emission limits as electrical-fieldstrength in dBµV/m. It is a widespread misperception that the observed spectrum may easily be translated into field strength, similar to how antenna factors are applied to antenna output voltage.

The GTEM-cell is typically used for relative measurements, tracking the EUT modifications with respect to the radiated spectrum. IEC 61000-4-2 describes an algorithm that needs measuring the EUT in its three primary orthogonal positions in order to correlate the measurement result with an OATS measurement. This algorithm is built into our EMCview software. The IEC 61000-4-2 approach is explained in greater detail in the TEM-cell FAQ document, which may be obtained from the Tekbox website.

When using this procedure, the EUT dimensions must not exceed one-third of the septum height. It should also be noted that the results of an OATS measurement are not equivalent to the results of semi-anechoic chamber measurements. Below 300 MHz, the correlation results are often lower than those of an OATS measurement. In our experience, the correlation results in the region of 250 MHz - 1 GHz tend to be within ± 5dB of the results in a semi-anechoic chamber. The correlation value is almost usually higher in the frequency band over 1 GHz when compared to the measurement in the semi-anechoic chamber. If the results above 1 GHz pass the limits of the standard, the unit will almost certainly pass in a semi-anechoic chamber.

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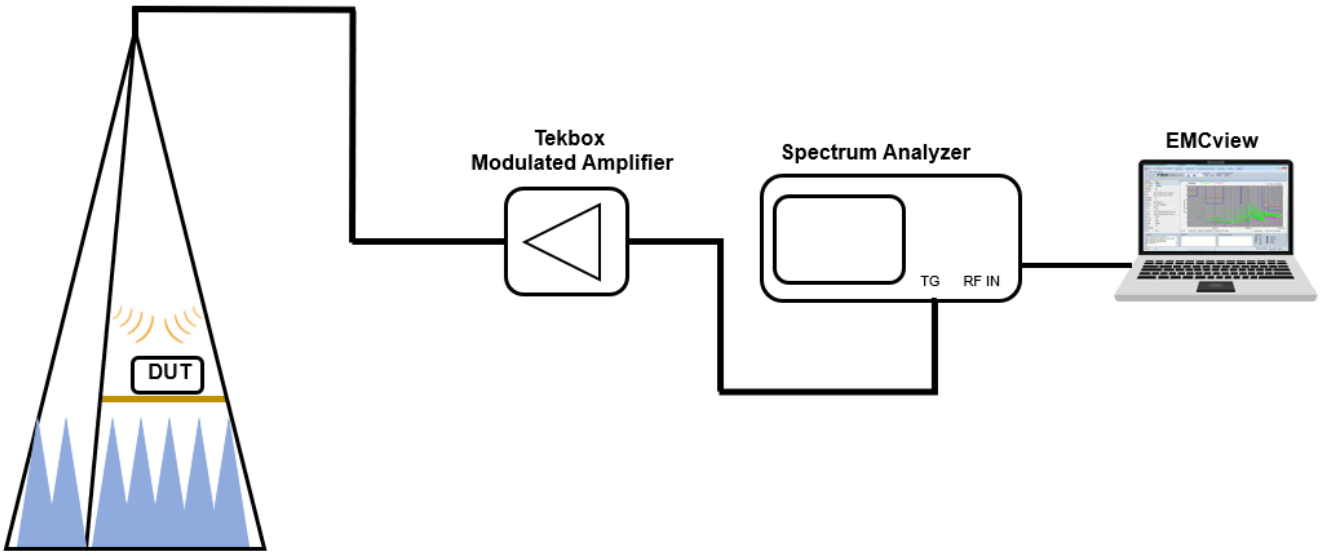
4.2 Radiated immunity tests:

The GTEM-cell will be connected to the output of a RF amplifier driven by a swept signal generator or spectrum analyzer tracking generator. The septum radiates the RF signal into the DUT. Typically, the RF signal is amplitude or pulse modulated.



radiated emission measurement using the TBGTC1 GTEM-cell, a Tekbox modulated RF power amplifier, spectrum analyzer tracking generator and EMCview

For calculating the required RF power for generating a given electric field strength between septum and lower wall of the TBGTC1, we need to use the following formula:

$$\boldsymbol{Power\ Required} = \frac{(\boldsymbol{E} * \boldsymbol{d})^2}{\boldsymbol{Z}} * \boldsymbol{Flatness} * \boldsymbol{Modulation\ Allowance}$$

Where E is the RMS electric field and d is the septum height

Z is the GTEM cell characteristic impedance =50 Ω

Modulation allowance = 3.24 (For 80% Amplitude Modulation)

Modulation allowance =1 (For non-modulated , CW)

Flatness = 2 (For 3 dB of flatness)

Assuming the DUT is placed in the center of the cell and in the middle between bottom wall and septum, we can however use the simplified formula for calculating the theoretical maximum field strength.

d = 10 cm E = (√(P*50Ω))*10

d = 15 cm E = (√(P*50Ω))*6.66

d = 20 cm E = (√(P*50Ω))*5

d = 25 cm E = (√(P*50Ω))*4

OPEN GTEM CELL FOR EMC PRE-COMPLIANCE TESTING

TBGTC1 , applied RF power	Maximum field strength between septum and wall
10W (40 dBm)	112 V/m
1 W (30 dBm)	35 V/m
0.1 W (20 dBm)	11 V/m
0.01 W (10dBm)	4 V/m

TBGTC1, field strength vs. RF power for d=200 mm

TBGTC1 , applied RF power	Maximum field strength between septum and wall
10W (40 dBm)	89 V/m
1 W (30 dBm)	28 V/m
0.1 W (20 dBm)	9 V/m
0.01 W (10dBm)	3 V/m

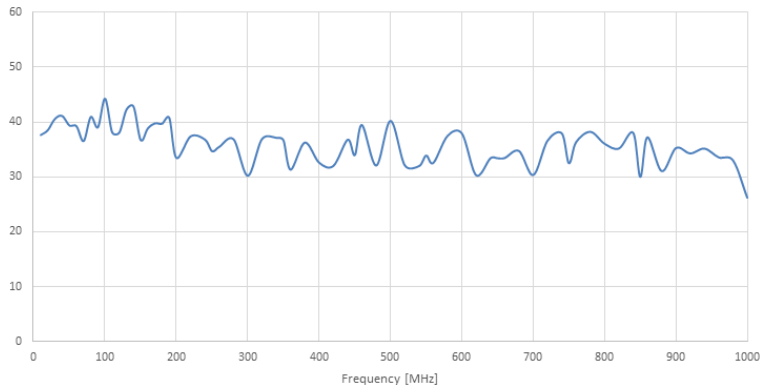
TBGTC1, field strength vs. RF power for d=250 mm

Tekbox provides a selection of modulated RF power amplifiers for low-cost immunity testing setups. These amplifiers include built-in modulators to generate the needed modulation forms and can thus be powered by the spectrum analyzer's tracking generator output. As a result, there is no need to purchase an RF signal generator. The spectrum analyzer tracking generator may be easily controlled using Tekbox's EMCview software.

Depending on the modulated RF power amplifier used and the septum height of the GTEM cell at the position of the EUT, this setup can create fieldstrengths of several hundred volts per metre. Refer to the datasheets of the modulated amplifiers for additional information.

The electric field is orthogonally aligned to the septum. To establish a worst-case situation for the EUT, position it within the TEM cell with the PCB traces orthogonally to the Septum, exposing it to the highest field gradient. If the EUT's dimensions allow for installation in all three orthogonal directions, the EUT must be placed and tested in all three orientations.

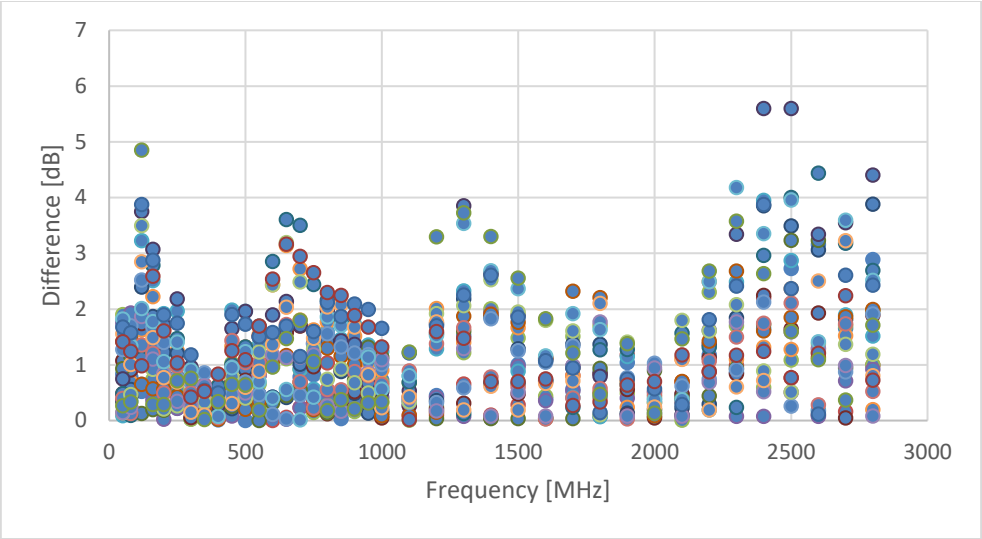
The field uniformity test is performed according to IEC 61000-4-20 standard for a 9-point calibration grid with the size of 200 mm x 200 mm at the septum height of 250 mm. Figure 7 shows the variation of the electric field vs frequency at the center point of the test volume for a given 5W constant forward power.



TBGTC1, electric field versus frequency

OPEN GTEM CELL FOR EMC PRE-COMPLIANCE TESTING

Also, the maximum difference in electric field components for 7 out of 9 points of the calibration grid is shown in figure 8.



TBGTC1, field uniformity test on a 9-point, 200 mm x 200 mm grid

The GTEM-cell E-field uniformity for at least four out of five calibration points is within the 6 dB criterion for frequencies up to 3 GHz.

5 Ordering Information

Part Number	**Description**
TBGTC1	Open GTEM cell, 250mm maximum septum height, Pyramidal foam absorbers 500 MHz - 40 GHz, N-Male to N-Male coaxial cable

Ordering Information

In order to reduce shipment cost, the GTEM-cell comes disassembled. An assembly instruction document and the necessary tools are added.

6 History

Version	Date	Author	Changes
V1.0	07.06.2023	Mayerhofer	Creation of the document

History