FCC ID: QLXGX120 Date of issue: 2007-09-21

DAT-P-225/96-02

Test Report
acc. to the relevant standard
47 CFR Part 15 C – Intentional Radiators
Measurement Procedure:
ANSI C63.4 - 2003
relating to
TeraTron GmbH
Hilti GX-120

Measurement of Radio- Noise Emissions
from Low- Voltage Electrical and Electronic Equipment
Technical characteristics and test methods for radio equipment
in the frequency range 9 kHz to 40 GHz

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FCC ID: QLXGX120 Date of issue: 2007-09-21

Manufacturer's details	
Manufacturer	**Tera Tron GmbH**
Manufacturer's grantee code	**QLX**
Manufacturer's address	**Tera Tron GmbH**
	Bunsenstrasse 10
	D-51647 Gummersbach
	Germany
	Phone: +49 2261 8082 0
	Fax: +49 2261 8082 99
	E-mail: michael.marquart@teratron.de
Relevant standard used	47 CFR Part 15C - Intentional Radiators
	ANSI C63.4-2003

Test report prepared by	
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Equipment **U**nder **T**est **(EUT)**	
Equipment category	Inductive system
Trade name	Hilti
Type designation	Hilti GX-120
Serial no.	none
Variants	---

FCC ID: QLXGX120 Date of issue: 2007-09-21

0 Test result

CFR Section	Report Chapter	Requirements Headline	Test result OK		
15.203	10.1	Antenna Requirement	**pass**	~~**fail**~~	~~**n.a.**~~
15.205 15.209	10.2	Radiated spurious emissions	**pass**	~~**fail**~~	~~**n.a.**~~

Test requirements kept	**yes** ~~**no**~~

Signature test personnel .....
Ralf Trepper

Signature of the company official .....
Manfried Dudde

FCC ID: QLXGX120 Date of issue: 2007-09-21

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1 Testing laboratory

Company name:	m.dudde hoch frequenz-technik
Street:	Rottland 5a
City:	51429 Bergisch Gladbach
Country:	Germany
Laboratory:	
	FCC Registration Number: 699717 This site has been fully described in a report submitted to the FCC and was accepted with letter dated Registration Number .699717
Phone:	+49-2207-9689-0
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2 Introduction

The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of m. dudde hochfrequenz - technik.

This report contains the result of tests performed by m. dudde hochfrequenz - technik for the purpose of a type approval. The order for carrying out these tests had been placed by:

Manufacturer

Company name	: Tera Tron GmbH
Address	: Bunsenstrasse 10
Postcode	: D-51647
City/town	: Gummersbach
Country	: Germany
Telephone	: +49 2261 8082 0
Telefax	: +49 2261 8082 99
E-mail	: michael.marquart@teratron.de
Date of order	: 2007-03-08
References	: Mr. Michael Marquart

3 Product

Samples of the following apparatus were submitted for testing:

Type of equipment	: Inductive system
Trademark	: Tera Tron GmbH
Type designation	: Hilti GX-120
Hardware version	: Hilti GX-120
Serial number	: ---
Software release	: ---
Power used	: 5.0 V DC
Frequency used	: 125.0 kHz
Generated or used frequencies	: 8.00 MHz / 125.0 KHz
ITU emission class	: 19K20 A1D
FCC ID	**: QLXGX120**

4 Test schedule

Tests were carried out in accordance with the specifications detailed in chapter 7 “Summary“ of this report.

Tests were carried out at:

- m. dudde hochfrequenz - technik, D-51429 Bergisch Gladbach

The test sample was received on:

- 2007-05-07

The tests were carried out in the following period of time:

- 2007-09-19

5 Product and measurement documentation

For issuing this report the following product documentation was used and the following annexes were created:

Description:	Date:	Identifications:
External photographs of the Equipment Under Test (EUT)	2007-01-23	Annex no. 1
Internal photographs of the Equipment Under Test (EUT)	2007-01-23	Annex no. 2
Occupied bandwidth plot	2007-07-14	Annex no. 3
Label sample	2007-08-14	Annex no. 4
Functional description	2007-01-23	Annex no. 5
Test setup photos	2007-07-14	Annex no. 6
Block diagram	2007-01-23	Annex no. 7
Schematics	2007-01-23	Annex no. 8
Technical description	2007-01-23	Annex no. 9

The above mentioned documentation will be filed at m. dudde hochfrequenz - technik for a period of 10 years following the issue of this test report.

6 Observations and comments

7 Summary

The product is intended for the use in the following areas of application:
Radio- Noise Emissions from Low- Voltage Electrical and Electronic Equipment
in the frequency range 9 kHz to 40 GHz

The samples were tested according to the following specification:

47 CFR Part 15C – Intentional Radiators, ANSI C63.4 - 2003

8 Conclusions

Samples of the apparatus were found to **CONFORM WITH** the specifications stated in chapter 7 "Summary" of this report.

In the opinion of m. dudde hochfrequenz - technik, the samples satisfied all applicable requirements relating to the network interface types specified in chapter 7 "Summary".

The results of the type tests as stated in this report are exclusively applicable to the product item as identified in this report. m. dudde hochfrequenz - technik does not accept any responsibility for the results stated in this report, with respect to the properties of product items not involved in these tests.

This report consists of a main module, modules with test results and annexes listed in chapter 5: "Product documentation". All pages have been numbered consecutively and bear the m. dudde hochfrequenz - technik logo, the report number and sub numbers.
The total number of pages in this report is **20.**

Tester:

Date : 2007-09-21

Name : Ralf Trepper

Signature :

Technical responsibility for area of testing:

Date : 2007-09-21

Name : Manfried Dudde

Signature :

9 Operation description

9.1 EUT details

Inductive System, Vehicle Immobilizer

9.2 EUT configuration

See Annex no. 5 (Functional description, User Manual)

9.3 EUT measurement description

The ***Hilti GX-120*** was tested in a typical fashion. During primary emission tests there had been examined all orthogonal adjustments of the EUT. In the final measurement there was chosen the adjustment in which there had been established before the highest level.

10.1 Antenna Requirement

10.1.1 Regulation

15.203 An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of Part 15C. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31 (d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

10.1.2 Result

The equipment meets the requirements	**yes**	~~**no**~~	~~**n.a.**~~

Further test results are attached	~~yes~~	**no**	page no:

n.a [x] see page no. 19

10.2 Radiated emission

10.2.1 Regulation

Test Requirement: FCC CFR47, Part 15B Test Procedure: ANSI C63.4:2003

15.109(a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency (MHz)	Field Strength (microvolts/meter)	Measurements distance (meters)
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

(c) In the emission tables above, the tighter limits applies at the band edges. Section 15.33 and 15.35 which specify the frequency range over which radiated emissions are to be measured and the detector functions and other measurement standards apply.

(f) For a receiver which employs terminals for the connection of an external receiving antenna, the receiver shall be tested to demonstrate compliance with the provisions of this Section with an antenna connected to the antenna terminals unless the antenna conducted power is measured as specified in Section 15.111(a). If a permanently attached receiving antenna is used, the receiver shall be tested to demonstrate compliance with the provisions of this Section.

Test Requirement: FCC CFR47, Part 15C Test Procedure: ANSI C63.4:2003

Section 15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	**Field strength (microvolts/meter)**	**Measurement distance (meters)**
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

(b) In the emission table above, the tighter limit applies at the band edges.

(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.

(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

(e) The provisions in §§ 15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part.

(f) In accordance with Section 15.33(a), in some cases the emissions from an intentional radiator must be measured to beyond the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator because of the incorporation of a digital device. lf measurements above the tenth harmonic are so required, the radiated emissions above the tenth harmonic shall comply with the general radiated emission limits applicable to the incorporated digital device, as shown in Section 15.109 and as based on the frequency of the emission being measured, or, except for emissions contained in the restricted frequency bands shown in Section 15.205, the limit on spurious emissions specified for the intentional radiator, whichever is the higher limit. Emissions which must be measured above the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator and which fall within the restricted bands shall comply with the general radiated emission limits in Section 15.109 that are applicable to the incorporated digital device.

10.2.2 Test equipment

Type	**Manufacturer/ Model no.**	**Serial no.**	**Last calibration**	**Next calibration**
Receiver (9 kHz –26.5 GHz)	Hewlett Packard Spectrum Analyzer 8593E (171)	3528U00990	2006/03	2008/03
Pre-amplifier (100kHz - 1.3GHz)	Hewlett Packard 8447 E (166a)	1726A00705	2006/03	2008/03
Magnetic antenna (9.0-30 MHz)	Schwarzbeck FMZB 1516 (23)	---	2004/04	2008/04
Bilog antenna (30-1000 MHz)	CHASE CBL611A (167)	1517	2004/04	2008/04
Horn antenna (0.86-8.5 GHz)	Schwarzbeck BBHA 9120 A (284)	236	1998/01	2008/01

10.2.3 Test procedures

The EUT and this peripheral (when additional equipment exist) are placed on a turn table which is 0.8 m above the ground. The turn table would be allowed to rotate 360 degrees to determine the position of the maximum emission level. The test distance between the EUT and the receiving antenna are 3m. To find the maximum emission, the polarization of the receiving antenna is changed in horizontal and vertical polarization, the position of the EUT was changed in different orthogonal determinations.
ANSI C63.4: 1992 Section 8 "Radiated Emissions Testing"

Radiated emissions test characteristics	
Frequency range	30 MHz - 4,000 MHz
Test distance	10m, 3 m*
Test instrumentation resolution bandwidth	9 kHz (20 kHz – 30 MHz)
	120 kHz (30 MHz - 1,000 MHz)
	1 MHz (1000 MHz - 12,000 MHz)
Receive antenna height	1 m (20 kHz – 30 MHz)
Receive antenna polarization	0° - 90° (20 kHz – 30 MHz)
Receive antenna scan height	1 m - 4 m (30 MHz - 12,000 MHz)
Receive antenna polarization	vertical/horizontal (30 MHz - 12,000 MHz)

* According to Section 15.31 (f)(1): At frequencies at or above 30 MHz, measurements may be performed at a distance other than what is specified provided: measurements are not made in the near field except where it can be shown that near field measurements are appropriate due to the characteristics of the device; and it can be demonstrated that the signal levels needed to be measured at the distance employed can be detected by the measurement equipment. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements; inverse-linear-distance-squared for power density measurements).

10.2.4 Calculation of field strength Section 15.209 below 30 MHz

The Receiver reading gives not directly the field strength result in (dBµV/m). The antenna factors of the loop antenna and cable losses must be added to find the correct result.

For frequencies below 30 MHz and for an test distance other than what is specified, but fulfilling the requirements of Section 15.31 (f) (2) the field strength is calculated by adding additionally an extrapolation factor of 40 dB/decade (inverse linear distance for field strength measurements).

The field strength is calculated by the following calculation:

Corrected Level = Receiver Level + Correction Factor

Corrected Level = Receiver Level + Correction Factor – Pre-amplifier (with the use of an Pre-amplifier)

Receiver Level : Receiver reading without correction factors
Correction Factor : Loop Antenna factor + cable loss

FS = 40.7 - 40 = 0.7 [dBµV/m]

Level in µV/m Common Antilogarithm (0.7/20) = 1.1

10.2.5 Calculation of field strength Section 15.209 above 30 MHz

The field strength is calculated by the following calculation:

Corrected Level = Receiver Level + Correction Factor (without the use of an Pre-amplifier)

Corrected Level = Receiver Level + Correction Factor – Pre-amplifier (with the use of an Pre-amplifier)

Receiver Level : Receiver reading without correction factors
Correction Factor : Antenna factor + cable loss

For test distance other than what is specified, but fulfilling the requirements of Section 15.31 (f)(1) the field strength is calculated by adding additionally an extrapolation factor of 20 dB/decade (inverse linear distance for field strength measurements).

10.2.6 Calculation of the field strength

The field strength is calculated by the following calculation:

Corrected Level = Receiver Level + Correction Factor (without the use of an Pre-amplifier)

Corrected Level = Receiver Level + Correction Factor – Pre-amplifier (with the use of an Pre-amplifier)

Receiver Level : Receiver reading without correction factors
Correction Factor : Antenna factor + cable loss

For example:

The receiver reading is 32.7 dBµV. The antenna factor for the measured frequency is +2.5 dB(1/m) and the cable factor for the measured frequency is 0.71 dB, giving a field strength of 35.91dBµV/m.
The 35.91dBµV/m value can be mathematically converted to its corresponding level in µV/m.

Level in µV/m = Common Antilogarithm (35.91/20) = 39.8

For test distance other than what is specified, but fulfilling the requirements of Section 15.31 (f)(1) the field strength is calculated by adding additionally an extrapolation factor of 20 dB/decade (inverse linear distance for field strength measurements).

10.2.7 Calculation of Average Correction Factor

The average correction factor is computed by analyzing the "worst case" on time in any 100msec time period and using the formula: Corrections Factor + 20*Iog (worst case on time/100msec) Analysis of the remote transmitter worst case on time in any 100msec time period is an on time of 50msec, there for the correction factor is 20*Iog(50/100) = - 6 dB. The maximum correction factor to be applied is 20 dB per section 15.35 of the FCC rules.

TRANSMITTER SPURIOUS RADIATION BELOW 30 MHz (Section 15.109)									
f (MHz)	Bandwidth (kHz), Type of detector	Noted receiver level **dBµV**	Test distance **m**	Correction factor **dB**	Distance extrapol. factor **dB**	Level corrected **dBµV/m**	Limit **dBµV/m**	Margin **dBµV/m**	Polarisation EUT / antenna orientation
0.1200	*QPK/0.2kHz*	*< 4.0*	*10*	20.2	*-59.1*	-34.90	*26.0 @ 300*	80.90	V, H/0-360°
0.5000	*QPK/0.2kHz*	*< 4.0*	*10*	20.2	*-19.1*	5.10	*33.6 @ 30*	28.5	V, H/0-360°
1.5000	*QPK/9kHz*	*< 4.0*	*10*	20.2	*-19.1*	5.10	*24.1 @ 30*	19.00	V, H/0-360°
3.0000	*QPK/9kHz*	*< 4.0*	*10*	20.2	*-19.1*	5.10	*29.5 @ 30*	24.4	V, H/0-360°
5.0000	*QPK/9kHz*	*< 4.0*	*10*	20.2	*-19.1*	5.10	*29.5 @ 30*	24.4	V, H/0-360°
8.0000	*QPK/9kHz*	*< 4.0*	*10*	20.2	*-19.1*	5.10	*29.5 @ 30*	24.4	V, H/0-360°
10.0000	*QPK/9kHz*	*< 4.0*	*10*	20.2	*-19.1*	5.10	*29.5 @ 30*	24.4	V, H/0-360°
20.0000	*QPK/9kHz*	*< 4.0*	*10*	20.2	*-19.1*	5.10	*29.5 @ 30*	24.4	V, H/0-360°
30.0000	*QPK/9kHz*	*< 4.0*	*10*	20.2	*-19.1*	5.10	*29.5 @ 30*	24.4	V, H/0-360°
No emissions detected									
Measurement uncertainty	4 dB								

Remark: *[1] Noise level of the measuring instrument ≤ 4.0dBµV @ 10m distance (0.009 MHz –30 MHz)
Remark: * Peak Limit according to Section 15.35 (b).

The equipment meets the requirements	**yes**	~~**no**~~	~~**n.a.**~~

Further test results are attached	~~yes~~	**no**	page no:

n.a [x] see page no. 19

TRANSMITTER SPURIOUS RADIATION ABOVE 30 MHz (Section 15.209)											
f (MHz)	Bandwidth (kHz)/Type of detector	Noted receiver level **dBµV**	Test distance **m**	Correction factor **dB**	Distance extrapol. factor **dB**	AV Correction factor **dB**	Level corrected **dBµV/m**	Limit **dBµV/m**	Margin **dBµV/m**	Polaris. EUT / antenna	Antenna height **cm**
30.0000	100, QPK	≤ 3.5	3	-2.60	0	0	0.90	40.00	39.10	H,V/H,V	100-400
88.0000	100, QPK	≤ 3.5	3	-10.80	0	0	-7.30	40.00	47.30	H,V/H,V	100-400
216.0000	100, QPK	≤ 3.5	3	-10.30	0	0	-6.80	43.50	50.30	H,V/H,V	100-400
960.0000	100, QPK	≤ 3.5	3	8.50	0	0	12.00	43.50	31.50	H,V/H,V	100-400
1700.0000	1000, AV	≤ 4.5	3	3.80	0	0	8.30	54.00	45.70	H,V/H,V	100-400
2250.0000	1000, AV	≤ 10	3	8.00	0	0	18.00	54.00	36.00	H,V/H,V	100-400
4000.0000	1000, AV	≤ 10	3	8.40*[6]	0	0	18.40	54.00	35.60	H,V/H,V	100-400
5000.0000	1000, AV	≤ 10	3	9.10*[6]	0	0	19.40	54.00	34.60	H,V/H,V	100-400
7500.0000	1000, AV	≤ 14	3	12.9*[6]0	0	0	26.90	54.00	27.10	H,V/H,V	100-400
8300.0000	1000, AV	≤ 14	3	14.80*[6]	0	0	28.80	54.00	25.20	H,V/H,V	100-400
9400.0000	1000, AV	≤ 14	3	16.00*[6]	0	0	30.00	54.00	24.00	H,V/H,V	100-400
11000.0000	1000, AV	≤ 14	3	18.25*[6]	0	0	32.25	54.00	21.75	H,V/H,V	100-400
Measurement uncertainty		4 dB									

* Bandwidth = the measuring receiver bandwidth

Remark: *[1] noise floor noise level of the measuring instrument ≤ 3.5dBµV @ 3m distance (30 – 1,000 MHz)
Remark: *[2] noise floor noise level of the measuring instrument ≤ 4.5 dBµV @ 3m distance (1,000 – 2,000 MHz)
Remark: *[3] noise floor noise level of the measuring instrument ≤ 10 dBµV @ 3m distance (2,000 – 5,500 MHz)
Remark: *[4] noise floor noise level of the measuring instrument ≤ 14 dBµV @ 3m distance (5,500 – 14,500 MHz)
Remark: *[5] for using a pre-amplifier in the range between 100 kHz and 1,000 MHz
Remark: *[6] for using a pre-amplifier in the range between 4.0 GHz and 18.0 GHz

The equipment meets the requirements	**yes**	~~**no**~~	~~**n.a.**~~

Further test results are attached	~~yes~~	**no**	page no:

n.a [x] see page no. 19

INTENTIONAL RADIATOR SPURIOUS RADIATION (Section 15.209(a))									
f (MHz)	Bandwidth (kHz), Type of detector	Noted receiver level **dBµV**	Test distance **m**	Correction factor **dB**	Distance extrapol. factor **dB**	Level corrected **dBµV/m**	Limit **dBµV/m**	Margin **dBµV/m**	Polarisation EUT / antenna orientation
0.125	*QPK/0.2kHz*	***25.6***	*10*	20.2	*-59.1*	**-13.3**	*AV19.2 @ 300*	**21.6**	V,0° / 0°
0.250	*QPK/0.2kHz*	*< 4.0*	*10*	20.2	*-59.1*	< -34.9	*AV9.6 @ 300*	44.5	V, H/0-360°
0.375	*QPK/0.2kHz*	*< 4.0*	*10*	20.2	*-59.1*	< -34.9	*AV6.4 @ 300*	41.3	V, H/0-360°
0.500	*QPK/9kHz*	*< 4.0*	*10*	20.2	*-19.1*	< 5.1	*AV48.0 @ 30*	42.9	V, H/0-360°
0.750	*QPK/9kHz*	*< 4.0*	*10*	20.2	*-19.1*	< 5.1	*AV38.4 @ 30*	33.3	V, H/0-360°
1.000	*QPK/9kHz*	*< 4.0*	*10*	20.2	*-19.1*	< 5.1	*AV32.0 @ 30*	26.9	V, H/0-360°
1.250	*QPK/9kHz*	*< 4.0*	*10*	20.2	*-19.1*	< 5.1	*AV27.4 @ 30*	22.3	V, H/0-360°
1.375	*QPK/9kHz*	*< 4.0*	*10*	20.2	*-19.1*	< 5.1	*AV24.0 @ 30*	18.9	V, H/0-360°
1.500	*QPK/9kHz*	*< 4.0*	*10*	20.2	*-19.1*	< 5.1	*AV21.3 @ 30*	16.2	V, H/0-360°
1.750	*QPK/9kHz*	*< 4.0*	*10*	20.2	*-19.1*	< 5.1	*AV19.2 @ 30*	14.1	V, H/0-360°
Measurement uncertainty		4 dB							

Remark: *[1] noise floor noise level of the measuring instrument ≤ 4.0dBµV @ 10m distance (0.009 – 30 MHz)
Remark: *[2] noise floor noise level of the measuring instrument ≤ 6.5dBµV @ 3m distance (30 – 1,000 MHz)
Remark: *[3] noise floor noise level of the measuring instrument ≤ 10 dBµV @ 3m distance (1,000 – 2,000 MHz)
Remark: *[4] noise floor noise level of the measuring instrument ≤ 17 dBµV @ 3m distance (2,000 – 5,500 MHz)
Remark: *[5] for using a pre-amplifier in the range between 100 kHz and 1,000 MHz

The equipment meets the requirements	**yes**	~~**no**~~	~~**n.a.**~~

Further test results are attached	~~yes~~	**no**	page no:

n.a [x] see page no. 19

11 Additional information to this test report

Remarks

n.a.[1] not applicable, because antenna is part of the PCB

n.a.[2] not applicable, because EUT is directly battery powered

End of test report

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