TEST REPORT # EMCC-931514.1YA, 2002-10-29

EQUIPMENT UNDER TEST:

Trade Name:	T70-USA Tx
Model:	T70-USA Tx
Serial No:	0195477
Equipment Category:	Transmitter
Manufacturer:	Digades GmbH
Address:	Äußere Weberstraße 20 02763 Zittau Germany
Phone:	+49-3583-5775-121
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RELEVANT STANDARD: 47 CFR Part 15C - Intentional Radiators

MEASUREMENT PROCEDURE USED:

☒ ANSI C63.4-1992 ☐ FCC/OET MP-4 (1987) ☐ Other

TEST REPORT PREPARED BY:

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1 GENERAL INFORMATION

1.1 Purpose

The purpose of this report is to show compliance to the FCC regulations for unlicensed devices operating under section 15.249 of the Code of Federal Regulations title 47.

1.2 Limits and Reservations

The test results in this report apply only to the particular Equipment Under Test (EUT) as declared in this report. This test report shall not be reproduced except in full without the written permission of EMCC DR. RAŠEK.

1.3 Test Location

Company Name:	EMCC DR. RAŠEK
Street:	Moggast 72-74
City:	91320 Ebermannstadt
Country:	Germany
Laboratory:	Test Laboratory of EMCC DR. RAŠEK FCC Registration Number: 90566 This site has been fully described in a report submitted to the FCC, and accepted in the letter dated February 09, 2000 Registration Number 90566.
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1.4 Manufacturer

Company Name:	Digades GmbH
Street:	Äußere Weberstraße 20
City:	02763 Zittau
Country:	Germany
Name for contact purposes:	Mr. Andreas Görnitz
Phone:	+49-3583-5775-121
Fax:	+49-3583-5775-222
E-mail:	agoernitz@digades.de

1.5 Dates

Date of receipt of EUT:	CW 42/2002
Test date:	CW 42/2002

2 PRODUCT DESCRIPTION

2.1 Equipment Under Test (EUT)

Device:	Remote control (RF) transmitter
Model:	T70-USA Tx
Serial Number:	0195477
Application:	Remote control system for car heating units
Power:	12 V DC, two 12 V Alkaline 3LR50 batteries in parallel
Transmit Frequency:	916.5 MHz, one RF channel
Modulation:	FSK
Oscillator Frequencies:	14.3203 MHz (reference oscillator), 916.5 MHz (VCO)
Antenna:	internal, integral
Interface ports:	none
Variants:	Variant with different housing
FCC-ID:	QNFT70-USA-TX

The EUT is the transmitter part of the system "Telestart T70", which is designed for remote controlling car heating units.
The EUT has two buttons. By pressing one of these two buttons, a telegram of 200 ms length is transmitted (ON-telegram in case of left button, OFF-telegram in case of right button). The EUT changes automatically to OFF-state after the telegram emission, even if the button is not released.

2.2 EUT Peripherals

The EUT was tested as stand-alone device.

2.3 Mode of Operation During Testing

The operation mode during testing had the following differences to normal operation mode:
- continuous transmission.

2.4 Modifications Required for Compliance

None.

3 TEST RESULTS SUMMARY

Summary of Test Results
Transmitter, model T70-USA Tx

Requirement	CFR Section	Report Section	Test Result
Antenna Requirement	15.203	4	Pass
Conducted Emissions	15.207	5	*
Field Strength Limits (Fundamental and Harmonics)	15.249	6	Pass
Radiated Spurious Emissions	15.209, 15.249	6	Pass

* Not required, the EUT is battery powered and there is no provision for connection to the mains.

The client has made the determination that EUT Condition, Characterization, and Mode of Operation are representative of production units, and meet the requirements of the specifications referenced herein.

Consistent with Industry practice, measurement and test equipment not directly involved in obtaining measurement results but having an impact on measurements (such as cable loss, antenna factors, etc.) are factored into the "Correction Factor" documented in certain test results. Instrumentation employed for testing meets tolerances consistent with known Industry Standards and Regulations.

The measurements contained in this report were made in accordance with the procedure ANSI C63.4 - 1992 and all applicable Public Notices received prior to the date of testing. All emissions from the device were found to be within the limits outlined in this report.
The test results in this report apply only to the particular Equipment Under Test (EUT) as declared in this report.

Test Personnel: Klaus Pfister
Issuance Date: 2002-10-29

4 ANTENNA REQUIREMENT

Test Requirement: FCC CFR47, Part 15C

4.1 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.

4.2 Result

Device: Remote Control (RF) Transmitter

Transmitter Model: T70-USA Tx

Antenna is directly soldered on the PCB.

The EUT meets the requirements of this section.

5 CONDUCTED EMISSIONS TEST

Test Requirement: FCC CFR47, Part 15C
Test Procedure: ANSI C63.4:1992

5.1 Regulation

Section 15.207 (a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	Quasi-peak (QP)	Average (AV)
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

Section 15.207 (c) Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provision for, the use of battery chargers which permit operating while charging, AC adaptors or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

5.2 Test Equipment

Not applicable.

5.3 Test Procedures

Not applicable.

5.4 Test Results

Device: Remote Control (RF) Transmitter

Transmitter Model: T70-USA Tx

The EUT is battery powered only. Therefore - according to Section 15.207 (d) - conducted emissions measurements to demonstrate compliance with the conducted limits are not required.

6 RADIATED EMISSIONS TEST

Test Requirement: FCC CFR47, Part 15C
Test Procedure: ANSI C63.4:1992

6.1 Regulation

Section 15.33 Frequency range of radiated measurements.

(a) Unless otherwise noted in the specific rule section under which the equipment operates for an intentional radiator the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the frequency shown in this paragraph:

(1) If the intentional radiator operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

Section 15.35 Measurement detector functions and bandwidths.

The conducted and radiated emission limits shown in this Part are based on the following, unless otherwise specified elsewhere in this Part:

(a) On any frequency or frequencies below or equal to 1000 MHz, the limits shown are based on measuring equipment employing a CISPR quasi-peak detector function and related measurement bandwidths, unless otherwise specified. The specifications for the measuring instrument using the CISPR quasi-peak detector can be found in Publication 16 of the International Special Committee on Radio Interference (CISPR) of the International Electrotechnical Commission. As an alternative to CISPR quasi-peak measurements, the responsible party, at its option, may demonstrate compliance with the emission limits using measuring equipment employing a peak detector function, properly adjusted for such factors as pulse desensitization, as long as the same bandwidths as indicated for CISPR quasi-peak measurements are employed.
Note: For pulse modulated devices with a pulse-repetition frequency of 20 Hz or less and for which CISPR quasi-peak measurements are specified, compliance with the regulations shall be demonstrated using measuring equipment employing a peak detector function, properly adjusted for such factors as pulse desensitization, using the same measurement bandwidths that are indicated for CISPR quasi-peak measurements.

(b) On any frequency of frequencies above 1000 MHz, the radiated limits shown are based upon the use of measurement instrumentation employing an average detector function. When average radiated emission measurements are specified in the regulations, including emission measurements below 1000 MHz, there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit for the frequency being investigated unless a different peak emission limit is otherwise specified in the rules in this part, e.g., see § 15.255. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz. Measurement of AC power line conducted emissions are performed using a CISPR quasi-peak detector, even for devices for which average radiated emission measurements are specified.

(c) Unless otherwise specified, e.g. Section 15.255(b), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification or shall be retained in the measurement data file for equipment subject to notification or verification.

Section 15.209 Radiated emission limits, general requirements.

(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.

Section 15.249 Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz, 5725 - 5875 MHz, and 24.0 - 24.25 GHz.

(a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency (MHz)	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902 - 928 MHz	50	500
2400 - 2483.5 MHz	50	500
5725 - 5875 MHz	50	500
24.0 - 24.25 GHz	250	2500

(b) Fixed, point-to-point operation as referred to in this paragraph shall be limited to systems employing a fixed transmitter transmitting to a fixed remote location. Point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information are not

allowed. Fixed, point-to-point operation is permitted in the 24.05-24.25 GHz band subject to the following conditions:

(1) The field strength of emissions in this band shall not exceed 2500 millivolts/meter.

(2) The frequency tolerance of the carrier signal shall be maintained within + 0.001% of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

(3) Antenna gain must be at least 33 dBi. Alternatively, the main lobe beamwidth must not exceed 3.5 degrees. The beamwidth limit shall apply to both the azimuth and elevation planes. At antenna gains over 33 dBi or beamwidths narrower than 3.5 degrees, power must be reduced to ensure that the field strength does not exceed 2500 millivolts/meter.

(c) Field strength limits are specified at a distance of 3 meters.

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in Section 15.209, whichever is the lesser attenuation.

(e) As shown in Section 15.35(b), for frequencies above 1000 MHz, the above field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For point-to-point operation under paragraph (b) of this section, the peak field strength shall not exceed 2500 millivolts/meter at 3 meters along the antenna azimuth.

6.2 Test Equipment

Type	Manufacturer/ Model No.	Serial No.	Last Calibration	Next Calibration
Receiver (30 MHz - 1 GHz)	Rohde & Schwarz ESS	832808/004	July 2002	January 2004
Antenna (30 MHz - 1 GHz)	EMCO Model 3143	9604-1269	June 2002	December 2003
Receiver (1 GHz - 10 GHz)	Rohde & Schwarz ESAI-D ESMI-RF ESMI-B1	833771/008 833827/002 832504/005	May 2002	November 2003
Antenna (1 GHz – 10 GHz)	Schwarzbeck BBHA 9120 D	137	October 2001	October 2003

6.3 Test Procedures

For tabletop equipment, the EUT is placed on a 1 meter by 1.5 meters wide and 0.8 meter high nonconductive table that is placed above the groundplane. Ceiling or wall-mounted devices also are positioned on a tabletop for testing purposes. Floor standing equipment is placed either directly on the groundplane or on insulating material if normally placed on a nonconducting floor *[Remark: not applicable].* The EUT is connected to its associated peripherals with any excess I/O cabling bundled to approximately 1 meter [*Remark: not applicable]*.

Preview tests are performed. Emissions from the unit are maximized by adjusting the polarization and height of the receive antenna and rotating the EUT on the turntable. Manipulating the system cables also maximizes EUT emissions *[Remark: not applicable]*. All tests performed with the EUT placed in two polarizations on the nonconductive table: horizontal and vertical.

Radiated Emissions Test Characteristics	
Frequency range	30 MHz - 10,000 MHz
Test distance	3 m *
Test instrumentation resolution bandwidth	120 kHz (30 MHz - 1,000 MHz), 1 MHz (1000 MHz - 10,000 MHz)
Receive antenna scan height	1 m - 4 m
Receive antenna polarization	Vertical/Horizontal

* 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).

6.4 Calculation of Field Strength Limits

Fundamental field strength limit for the band 902 to 928 MHz:
50 mV/m at 3 meters; 50 mV/m corresponds with 94.0 dB(µV/m).

Harmonics field strength limit for the band 902 to 928 MHz:
500 µV/m at 3 meters; 500 µV/m corresponds with 54.0 dB(µV/m).

Emissions radiated outside the frequency band 902 to 928 MHz, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in Section 15.209, whichever is the lesser attenuation.
Conversion: microvolts/meter to dB(µV/m):

Frequency	Field Strength Limits *		Measurement distance
[MHz]	Section 15.209	50 dB below the level of the fundamental **	[m]
30-88	100 µV/m ≙ 40.0 dB(µV/m)	**41.8** dB(µV/m)	3
88-216	150 µV/m ≙ **43.5** dB(µV/m)	41.8 dB(µV/m)	3
216-960	200 µV/m ≙ **46.0** dB(µV/m)	41.8 dB(µV/m)	3
Above 960	500 µV/m ≙ **54.0** dB(µV/m)	41.8 dB(µV/m)	3

* According to Section 15.249 the less stringent limit (in **bold letters**) applies
** Level of the fundamental see chapter 6.7 of this test report

6.5 Calculation of Average Correction Factor

The average correction factor is computed by analyzing the "worst case" on time in any 100 ms time period and using the formula:

Correction Factor (dB) = 20*log (worst case on time/100 ms)

Section 15.249 Info: For the fundamental carrier in the 902-928 MHz band, no duty cycle correction factor is permitted. This is a quasi-peak measurement.

6.6 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and the Cable Factor. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF
where
FS = Field Strength in dB(µV/m)
RA = Receiver Amplitude in dB(µV)
AF = Antenna Factor in dB(1/m)
CF = Cable Attenuation Factor in dB

Assume a receiver reading of 23.5 dB(µV) is obtained. The Antenna Factor of 7.4 dB(1/m) and a Cable Factor of 1.1 dB are added, giving a field strength of 32 dB(µV/m). The 32 dB(µV/m) value can be mathematically converted to its corresponding level in µV/m.

FS = 23.5 dB(µV) + 7.4 dB(1/m) + 1.1 dB = 32 dB(µV/m)

FS = $10^{(32/20)}$ µV/m = 39.8 µV/m

For test distances 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). The basic equation with a sample calculation is as follows:

FS = RA + AF + CF + DF
where
FS = Field Strength in dB(µV/m)
RA = Receiver Amplitude in dB(µV)
AF = Antenna Factor in dB(1/m)
CF = Cable Attenuation Factor in dB
DF = Distance Extrapolation Factor in dB,
where DF = 20 log(D_{test}/D_{spec}) where D_{test} = test distance and D_{spec} = specified distance

Assume the tests performed at a reduced test distance of 1.5 m instead of the specified distance of 3 m giving a Distance Extrapolation Factor of DF = 20 log(1.5m/3m) = -6 dB.
Assuming a receiver reading of 23.5 dB(µV) is obtained. The Antenna Factor of 7.4 dB(1/m), the Cable Factor of 1.1 dB and the Distance Factor of -6 dB are added, giving a field strength of 26 dB(µV/m). The 26 dB(µV/m) value can be mathematically converted to its corresponding level in µV/m.

FS = 23.5 dB(µV) + 7.4 dB(1/m) + 1.1 dB – 6 dB = 26 dB(µV/m)

FS = $10^{(26/20)}$ µV/m = 20.0 µV/m

6.7 Test Results

PRODUCT EMISSIONS DATA, FUNDAMENTAL AND HARMONICS											
No	Emission Frequency [MHz]	Receiver Bandwidth and Mode [kHz]	Test Dist-ance [m]	Receiver Reading RA [dB(µV)]	Correction Factor AF+CF [dB(1/m)]	Distance Extrapol. Factor DF [dB]	Average Correct-ion Factor [dB]	Result = Corrected Reading FS [dB(µV/m)]	Spec Limit [dB(µV/m)]	Polari-zation Ant.	Margin [dB]
1	916.50	120, QP	3	QP 64.2	27.6	0	0	QP 91.8	QP 94.0	h	QP 2.2
2	1833	1000, PK	1.5	PK 23.7	26.1	-6	0	PK 43.8	AV 54.0 PK 74.0	v	AV ≥ 10.2 PK 30.2
3	2750	1000, PK	1.5	PK 24.5	29.2	-6	0	PK 47.7	AV 54.0 PK 74.0	h	AV ≥ 6.3 PK 26.3
4	3666	1000, PK	1.5	PK 22.9	30.1	-6	0	PK 47.0	AV 54.0 PK 74.0	v	AV ≥ 7.0 PK 27.1
5											
6											

PRODUCT EMISSIONS DATA ABOVE 30 MHz (except fundamental and harmonics)											
No	Emission Frequency [MHz]	Receiver Bandwidth and Mode [kHz]	Test Dist-ance [m]	Receiver Reading RA [dB(µV)]	Correction Factor AF+CF [dB(1/m)]	Distance Extrapol. Factor DF [dB]	Average Correct-ion Factor [dB]	Result = Corrected Reading FS [dB(µV/m)]	Spec Limit * 15.209 / 15.249 [dB(µV/m)]	Polari-zation Ant.	Margin [dB]
1											
2											
3											
4											
5											
6											

ALL EMISSIONS MORE THAN 15 dB BELOW CORRESPONDING LIMIT

Device: Remote Control (RF) Transmitter

Transmitter Model: T70-USA Tx

The EUT meets the requirements of this section.

Test Personnel: Klaus Pfister

Test Date: 2002-06-24, 2002-06-25

For transmitter bandwidth plots refer to Annex 2.

7 MISCELLANEOUS COMMENTS AND NOTES

None.

8 LIST OF ANNEXES

Following annexes are separated parts to this test report.

Description	Pages
Annex 1: Photographs of test setups	3
Annex 2: Transmitter bandwidth plots	2