TEST REPORT # EMCC-010133AC, 2002-01-31

EQUIPMENT UNDER TEST:

Trade Name:	ILR®
Model:	i-D2
Serial No:	None
Equipment Category:	Transceiver; Active Transponder
Manufacturer:	IDENTEC SOLUTIONS AG
Address:	Millenium Park 2 A-6890 Lustenau Austria
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RELEVANT STANDARD: 47 CFR Part 15

MEASUREMENT PROCEDURE USED:

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

TEST REPORT PREPARED BY:

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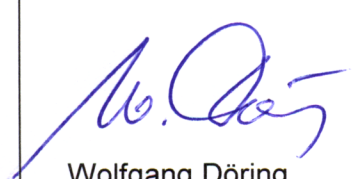
TEST PERSONNEL:



Wolfgang Döring

HEAD OF LABORATORY:

Winfried Hoffmann

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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 15.231 of the Code of Federal Regulations title 47.
Furthermore the receiver part was investigated to the requirements of section 15.109.

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.
Phone:	+49-9194-9016
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1.4 Manufacturer

Company Name:	IDENTEC SOLUTIONS AG
Street:	Millenium Park 2
City:	A-6890 Lustenau
Country:	Austria

Name for contact purposes:	Mr. Reinhold Gantner
Phone:	+43-5577-87 387-70
Fax:	+43-5577-87 387-15
E-mail:	r.gantner@identecsolutions.at

1.5 Dates

Date of receipt of EUT:	CW 03/2002
Test date:	CW 03+04/2002

2 PRODUCT DESCRIPTION

2.1 Equipment Under Test (EUT)

Device:	ILR® Transponder
Model:	i-D2
Serial Number:	None; Sample marking: #1, #2 and #3)
FCC ID:	OO4-ILR-ID2
Power:	Lithium Battery 3.0 V
Transmit Frequency:	868.3 MHz
Receive Frequencies:	868 MHz (EC) and 915 MHz (US) ISM Bands
Internal clock frequencies:	27.1344 MHz
Lowest frequency generated in the device:	1 MHz
Antenna:	internal, integral
Interface ports:	none
Variants:	none

2.2 EUT Peripherals

The EUT were tested as stand-alone devices.

2.3 Mode of Operation During Testing

The transceiver was tested in a typical fashion.

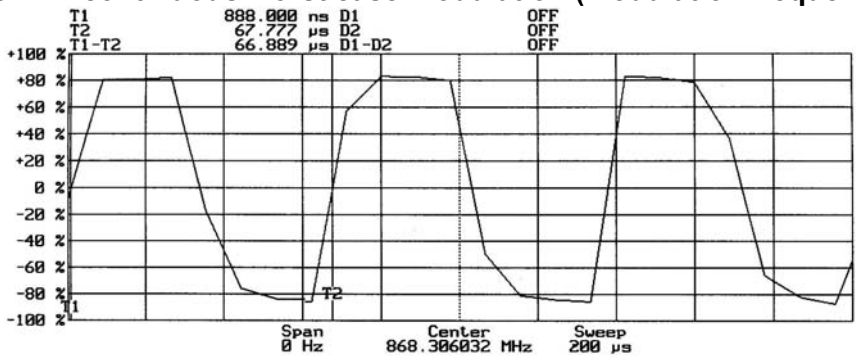
There were three samples supplied for testing purposes as following:

Sample #3 – normal operation

Sample number 3 works in normal mode. This means when a correct command from the interrogator is received, the transponder responses with the respective answer. This sample has the identification number: 80080

The other samples (no.1 and no.2) are for testing purposes only and working in transmit mode.

Sample #1 – continuous worst case modulation (modulation frequency 14,66 kHz)

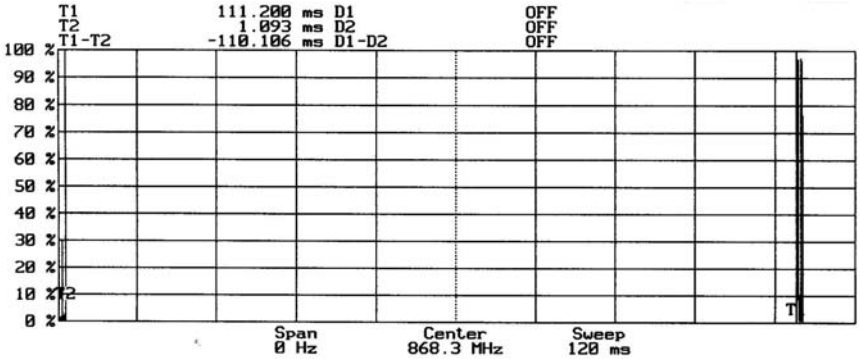


Plot 1 – continuos modulation (spectrum analyzer output at transmit frequency)

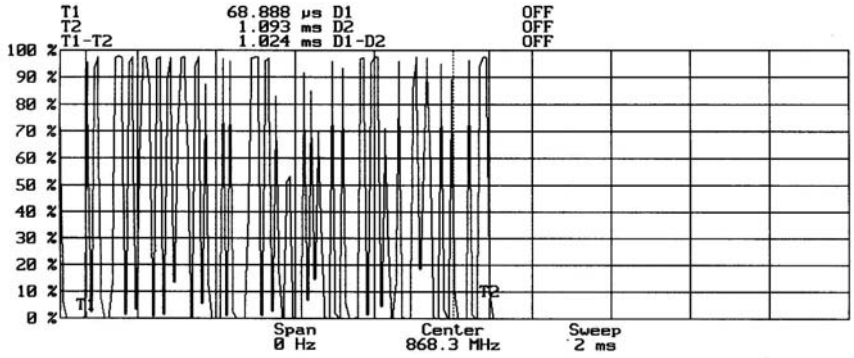
The RF – output is continuously modulated with a 50 % on / off signal respective to the communication baud rate from 38400 baud. This sample has no identification number.

Sample #2 – representative answer burst

This sample sends every 110 msec a burst that is representative for a scan answer. The data content of this burst is changed by a pseudo random generator, so that each telegram is different.



Plot 2 – burst cycle



Plot 3 – burst duration.

2.4 Modifications Required for Compliance

None.

3 TEST RESULTS SUMMARY

Summary of Test Results
IDENTEC SOLUTIONS ILR® Transponder, model i-D2

Requirement	CFR Section	Report Section	Test Result
Antenna Requirement	15.203	4	Pass
Radiated Spurious Emissions	15.109, 15.209, 15.205(b), 15.231	5	Pass
Conducted Emissions	15.207(b)	6	*
Periodic Operation Characteristics	15.231(a)	7	Pass
Field Strength Limits (Fundamental)	15.231(b)	5	Pass
20 dB Bandwidth	15.231(c)	9	Pass

* Not required, the EUT is battery powered.

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: Wolfgang Döring
Issuance Date: 2002-01-31

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:	IDENTEC SOLUTIONS ILR® Transponder
Model:	i-D2
Tested Samples:	Samples #1, #2 and #3

Antenna is a trace on the PCB.

The EUT meets the requirements of this section.

5 RADIATED EMISSIONS

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

5.1 Regulation

Section 15.31 (e) For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

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.

(4) If the intentional radiator contains a digital device, regardless of whether this digital device controls the functions of the intentional radiator or the digital device is used for additional control or function purposes other than to enable the operation of the intentional radiator, the frequency range shall be investigated up to the range specified in paragraphs (a)(1)-(a)(3) of this section or the range applicable to the digital device, as shown in paragraph (b)(1) of this Section, whichever is the higher frequency range of investigation.

(b) For unintentional radiators *[Remark: Applies to the receiver part / receive mode]*:
(1) Except as otherwise indicated in paragraphs (b)(2) or (b)(3), for an unintentional radiator, including a digital device, the spectrum shall be investigated from the lowest radio frequency signal generated or used in the device, without going below the lowest frequency for which a radiated emission limit is specified, up to the frequency shown in the following table:

Highest frequency generated or used in the device or on which the device operates or tunes (MHz)	Upper frequency of measurement (MHz)
Below 1.705	30
1.705 - 108	1000
108 - 500	2000
500 - 1000	5000
Above 1000	5th harmonic of the highest frequency or 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 quasipeak 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 (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	Field Strength	Measurement distance
(MHz)	(microvolts/meter)	(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. If 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.

Section 15.109 Radiated emission limits *[Remark: Applies to the receiver part / receive mode].*
(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	Field Strength
(MHz)	(microvolts/meter)
30–88	100
88–216	150
216–960	200
Above 960	500

15.231(b) In addition to the provisions of Section 15.205, the field strength of emissions from intentional radiators operated under this Section shall not exceed the following:

Fundamental Frequency (MHz)	Field Strength of Fundamental (microvolts/meter)	Field Strength of Spurious Emissions (microvolts/meter)
40.66 - 40.70	2,250	225
70 - 130	1,250	125
130 - 174	1,250 to 3,750 **	125 to 375 **
174 - 260	3,750	375
260 - 470	3,750 to 12,500 **	375 to 1,250 **
Above 470	12,500	1,250

** Linear interpolations

[Where F is the frequency in MHz, the formulas for calculating the maximum permitted fundamental field strengths are as follows: for the band 130-174 MHz, μV/m at 3 meters = 56.81818(F) - 6136.3636; for

the band 260-470 MHz, µV/m at 3 meters = 41.6667(F) - 7083.3333. The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.]

(1) The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.

(2) Intentional radiators operating under the provisions of this Section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provisions in Section 15.35 for averaging pulsed emissions and for limiting peak emissions apply. Further, compliance with the provisions of Section 15.205 shall be demonstrated using the measurement instrumentation specified in that section.

(3) The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in Section 15.209, whichever limit permits a higher field strength

5.2 Radiated Emissions Test, 9 kHz to 30 MHz (Magnetic Field Test)

5.2.1 Test Equipment

Type	Manufacturer/ Model No.	Serial No.	Last Calibration	Next Calibration
Receiver (9 kHz - 1 GHz)	Rohde & Schwarz ESS	/004	July 2001	July 2003
Loop Antenna (150 kHz – 30 MHz)	R&S HFH 2-Z2	892665/004	June 2000	June 2002

5.2.2 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 sits on a flush mounted metal turntable. Floor standing equipment is placed directly on the flush mounted metal turntable *[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 to determine the "worst case" mode of operation.

Emissions from the unit are maximized by adjusting the orientation of the receive loop 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. Refer to the photographs' section. Refer to the photographs' section.

The test distance was reduced to 1 m, respectively. according to section 15.31 (f) (2).
The initial step in collecting radiated data is a peak scan of the measurement range with an EMI test receiver. The significant peaks within a margin of 25 dB to the limit are then measured with quasi-peak and AV detector, respectively.
Worst case radiated emissions are listed under chapter: test results.

Radiated Emissions Test Characteristics (magnetic field test)	
Frequency range	9 kHz - 30 MHz
Test distance	1 m*
Test instrumentation resolution bandwidth	10 kHz (150 kHz - 30 MHz)
Test instrumentation detector	QP / AV, Peak
Receive antenna height	1 m
Receive antenna orientation	0 - 360°

* Section 15.31 (f) (2) At frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field. Pending the development of an appropriate measurement procedure for measurements performed below 30 MHz, when performing measurements at a closer distance than specified, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade).

5.2.3 Calculation of Field Strength Limits

Calculation: microvolts/meter to dBµV/m

Frequency	Field Strength Limit according to Section 15.209		Measurement distance
(MHz)	(µV/m)	(dBµV/m)	(meters)
0.009–0.490	266.7-4.9	48.5-13.8	300
0.490–1.705	49.0-14.1	33.8-23.0	30
1.705–30.0	30	29.5	30

5.2.4 Field Strength Calculation

For obtaining the field strength in dBµV/m a conversion factor of 20log(377) = 51,5 dB is necessary, because the EMI receiver and the active loop antenna operate as a system, where the reading gives directly the H field strength result (dBµA/m). The gain, antenna factors and cable losses are already taken into consideration.

For 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 basic equation with a sample calculation is as follows:

FS = RA + CO + DF
where
FS = Field Strength in dBµV/m
RA = Receiver Amplitude in dBµA/m
CO = Conversion Factor in dBΩ
DF = Distance Extrapolation Factor in dB,
where DF = 20 log (Dtest/Dspec) where Dtest = Test Distance and Dspec = Specified Distance

Assume the tests performed at a reduced Test Distance of 1 m instead of the Specified Distance of 30 m giving a Distance Extrapolation Factor of DF = 40 log(1m/30m) = -59.1 dB.
Assuming a receiver amplitude of –10.8 dBµA/m is obtained. Adding the conversion factor of 51.5 dBΩ a corresponding level of 40.7 dBµV/m is obtained. The distance factor of –59.1 dB is added, giving a field strength of -18.4 dBµV/m. The –18.4 dBµV/m value can be mathematically converted to its corresponding level in µV/m.

FS = -10.8 + 51.5 – 59.1 = -18.4 [dBµV/m]

Level in µV/m = Common Antilogarithm (-18.4/20) = 0.12

5.2.5 Test Results

Device: IDENTEC SOLUTIONS ILR® Transponder
Model: i-D2
Tested Samples: Sample #1 (Transmit mode)
Sample #3 (Receive mode)

PRODUCT EMISSIONS DATA 150 kHz - 30 MHz										
No	Emission Frequency	Receiver Mode and Bandwidth	Test Distance	Receiver Reading RA	Conver-sion Factor CO	Distance Extrapola-tion Factor DF	Result = Corrected Reading FS	Spec Limit @ Distance	Margin	Remarks
	[MHz]	[kHz]	[m]	[dBµA/m]	[dBΩ]	[dB]	[dBµV/m]	[dBµV/m] @ [m]	[dB]	
1	0.155	Pk/10kHz AV/10kHz	1	-12 -18.2	51.5	-99.1	-59.6 -65.8	43,8 Pk* @ 300 23,8 AV @ 300	103.4 Pk 89.6 AV	ambient noise floor
2	0.205	Pk/10kHz AV/10kHz	1	-15 -24.1	51.5	-99.1	-62.6 -71.7	61,4 Pk* @ 300 41,4 AV @ 300	124 Pk 113.1 AV	ambient noise floor
3	0.55	QP/10kHz	1	-25.7	51.5	-59.1	-26.2	32.8 QP @ 30	59	ambient; broadcast signal
4	0.82	QP/10kHz	1	-25.8	51.5	-59.1	-33.4	29.3 QP @ 30	62.7	ambient noise floor
5	3.085	QP/10kHz	1	-26.5	51.5	-59.1	-34.1	29.5 QP @ 30	63.6	ambient noise floor
6	25.92	QP/10kHz	1	-26.3	51.5	-59.1	-33.9	29.5 QP @ 30	63.4	ambient noise floor

Remarks: No product emissions found. *Peak Limit according to Section 15.35 (b).

The EUT meets the requirements of this section.

Test Personnel: Wolfgang Döring

Test Date: 2002-01-22

5.3 Radiated Emissions Test, 30 MHz to 9 GHz

5.3.1 Test Equipment

Type	Manufacturer/ Model No.	Serial No.	Last Calibration	Next Calibration
Antenna (30 MHz - 1 GHz; Final Measurement)	EMCO Model 3143	9604-1269	Oct. 2000	April 2002
Antenna (30 MHz - 1 GHz; Pre-test)	EMCO Model 3142	9601-1002	Oct. 2000	April 2002
Receiver (30 MHz – 9 GHz)	Rohde & Schwarz ESAI-D ESMI-RF ESMI-B1	833771/008 833827/002 832504/005	June 2000	June 2002
Antenna (1 GHz – 9 GHz)	Schwarzbeck BBHA 9120 D	248	Sept. 2001	Sept. 2003

5.3.2 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 sits on a flush mounted metal turntable. Floor standing equipment is placed directly on the flush mounted metal turntable *[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 using sample #1. With the EUT operating in "worst case" mode, emissions from the unit are maximized by adjusting the polarization and height of the receive antenna and rotating the EUT on the turntable. Final measurements performed on samples #1 (RX mode) and #2 (TX mode), respectively. 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. Refer to the photographs' section.

Radiated Emissions Test Characteristics	
Frequency range	30 MHz - 9,000 MHz
Test distance	3 m*
Test instrumentation resolution bandwidth	120 kHz (30 MHz - 1,000 MHz)
	1 MHz (1000 MHz - 9,000 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).

5.3.3 Calculation of Field Strength Limits

Fundamental field strength limits for the band above 470 MHz:

µV/m at 3 meters = 12,500

12,500 µV/m corresponds with 81.9 dBµV/m.

The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level, i.e. 61.9 dBµV/m.

5.3.4 Calculation of Average Correction Factor

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

Corrections Factor (dB) + 20*log (worst case on time/100 mSec)

The following calculation is related to Sample #2 – representative answer burst. [Refer to chapter 2.3, plots 2 and 3.]

Analysis of the transmitter worst case on time in any 100 mSec time period is an on time of 0.6 mSec, therefor the correction factor is 20*log (0.6/100) = - 44.4 dB.

The relationship between average and peak mode reading has been confirmed by direct measurement using the receiver's average and peak detectors.

All emission measurements performed using the test receiver's average detector and the max. hold facility; i.e. the average value measured directly without the necessity of additional correction factor.

5.3.5 Field Strength Calculation

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

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

Assume a receiver reading of 23.5 dBµV 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 dBµV/m. The 32 dBµV/m value can be mathematically converted to its corresponding level in µV/m.

FS = 23.5 + 7.4 + 1.1 = 32 [dBµV/m]

Level in µV/m = Common Antilogarithm (32/20) = 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). The basic equation with a sample calculation is as follows:

FS = RA + AF + CF + DF
where
FS = Field Strength in dBµV/m
RA = Receiver Amplitude in dBµV
AF = Antenna Factor in dB(1/m)
CF = Cable Attenuation Factor in dB
DF = Distance Extrapolation Factor in dB,
where DF = 20 log (Dtest/Dspec) where Dtest = Test Distance and Dspec = 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 dBµV 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 dBµV/m. The 26 dBµV/m value can be mathematically converted to its corresponding level in µV/m.

FS = 23.5 + 7.4 + 1.1 - 6 = 26 [dBµV/m]

Level in µV/m = Common Antilogarithm (26/20) = 20

5.3.6 Test Results

Device: IDENTEC SOLUTIONS ILR® Transponder
Model: i-D2
Tested Samples: Sample #2 (Transmit mode)

PRODUCT EMISSIONS DATA 15.231 BANDS										
No	Emission Frequency [MHz]	Receiver Mode and Bandwidth [kHz]	Test Distance [m]	Receiver Reading RA [dBµV]	Correction Factor AF+CF [dB(1/m)]	Distance Extrapola-tion Factor DF [dB]	Result = Corrected Reading FS [dBµV/m]	Spec Limit [dBµV/m]	Polarization Ant	Margin [dB]
1	868.3	120, AV 120, Pk	3	AV 10.5 Pk 54.2	26.9	0	AV 37.4 Pk 81.1	AV 81.9 Pk* 101.9	v	AV 44.5 Pk 20.8
2	841.1	120, AV 120, Pk	3	AV -1.9 Pk 19.6	26.4	0	AV 24.5 Pk 46	AV 61.9 Pk* 81.9	v	AV 37.4 Pk 35.9
3	895.4	120, AV 120, Pk	3	AV -1.7 Pk 21.3	27.6	0	AV 25.9 Pk 48.9	AV 61.9 Pk* 81.9	v	AV 36 Pk 33
4	1736.6	1000, AV 1000, Pk	1.5	AV 10.8 Pk 47.2	24.9	-6	AV 29.7 Pk 66.0	AV 61.9 Pk* 81.9	v	AV 32.2 Pk 15.9
5	2604.9	1000, AV 1000, Pk	1.5	AV 6.6 Pk 38.1	27.7	-6	AV 28.3 Pk 59.8	AV 61.9 Pk* 81.9	h	AV 33.6 Pk 22.1
6	3473.2	1000, AV 1000, Pk	1.5	AV 6.8 Pk 39.3	28.4	-6	AV 29.2 Pk 61.7	AV 61.9 Pk* 81.9	v	AV 32.7 Pk 20.2

Remark: * Peak Limit according to Section 15.35 (b).

PRODUCT EMISSIONS DATA 15.205 BANDS										
No	Emission Frequency [MHz]	Receiver Mode and Bandwidth [kHz]	Test Distance [m]	Receiver Reading RA [dBµV]	Correction Factor AF+CF [dB(1/m)]	Distance Extrapola-tion Factor DF [dB]	Result = Corrected Reading FS [dBµV/m]	Spec Limit [dBµV/m]	Polarization Ant	Margin [dB]
1	4341.5	1000, AV 1000, Pk	1.5	AV 6.6 Pk 24.2	30.3	-6	AV 30.9 Pk 48.5	AV 54 Pk* 74	h	AV 23.1 Pk 25.5

Device: IDENTEC SOLUTIONS ILR® Transponder
Model: i-D2
Tested Samples: Sample #3 (Receive mode)

PRODUCT EMISSIONS DATA 15.109 (Receiver Part / Receive Mode)										
No	Emission Frequency [MHz]	Receiver Mode and Bandwidth [kHz]	Test Distance [m]	Receiver Reading RA [dBµV]	Correction Factor AF+CF [dB(1/m)]	Distance Extrapola-tion Factor DF [dB]	Result = Corrected Reading FS [dBµV/m]	Spec Limit [dBµV/m]	Polarization Ant	Margin [dB]
1	30 - 88	120, Pk	3	< 3*	9.3 – 13.9	0	< 16.9	QP 40	h, v	> 23
2	88 – 216	120, Pk	3	< 5*	9.5 – 13.2	0	< 18.2	QP 43.5	h, v	> 25
3	216 – 960	120, Pk	3	< 5*	13.2 – 29.8	0	< 34.8	QP 46	h, v	> 11
4	960 - 1000	120, Pk	3	< 5*	29.8 - 31	0	< 35.3	Pk 54	h, v	> 18.5
5	1000 - 9000	1000, Pk	1	< 18*	24.7 - 37	-9.5	< 49.5	Pk 54	h, v	> 14.5

* No emissions found; all readings: max. Pk reading.

The EUT meets the requirements of this section.

Test Personnel: Wolfgang Döring

Test Date: 2002-01-16

6 CONDUCTED EMISSIONS TESTS

Test Requirement: FCC CFR47, Part 15C

Test Procedure: ANSI C63.4:1992

6.1 Regulation

Section 15.207 (a) For an intentional radiator which 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 450 kHz to 30 MHz shall not exceed 250 microvolts. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals.

Section 15.207 (d) 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.

6.2 Test Equipment

Not applicable.

6.3 Test Procedures

Not applicable.

6.4 Test Results

Device: IDENTEC SOLUTIONS ILR® Transponder
Model: i-D2

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.

7 PERIODIC OPERATION CHARACTERISTICS

Test Requirement: FCC CFR47, Part 15C

7.1 Periodic Operation

7.1.1 Regulation

15.231(a) The provisions of this Section are restricted to periodic operation within the band 40.66 - 40.70 MHz and above 70 MHz. Except as shown in paragraph (e) of this Section, the intentional radiator is restricted to the transmission of a control signal such as those used with alarm systems, door openers, remote switches, etc. Radio control of toys is not permitted. Continuous transmissions, such as voice or video, and data transmissions are not permitted. The prohibition against data transmissions does not preclude the use of recognition codes. Those codes are used to identify the sensor that is activated or to identify the particular component as being part of the system.

7.1.2 Result

Device:	IDENTEC SOLUTIONS ILR® Transponder
Model:	i-D2
Tested Samples:	Sample #3 (Normal operation mode)

The EUT meets the requirements of this section.

7.2 Manually Operated Transmitter Deactivation

7.2.1 Regulation

15.231(a1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

7.2.2 Result

Device:	IDENTEC SOLUTIONS ILR® Transponder
Model:	i-D2
Tested Samples:	Sample #3 (Normal operation mode)

The EUT does not employ manual transmission control.

7.3 Automatically Operated Transmitter Deactivation

7.3.1 Regulation

15.231(a2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.

7.3.2 Result

Device: IDENTEC SOLUTIONS ILR® Transponder
Model: i-D2
Tested Samples: Sample #3 (Normal operation mode)

Transmitter ceases immediately after transmitting the data block, i.e. within miliseconds. The EUT meets the requirements of this section.

7.4 Prohibition of Periodic Transmission

7.4.1 Regulation

15.231(a3) Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions to determine system integrity of transmitters used in security or safety applications are allowed if the periodic rate of transmission does not exceed one transmission of not more than one second duration per hour for each transmitter.

7.4.2 Result

Device: IDENTEC SOLUTIONS ILR® Transponder
Model: i-D2
Tested Samples: Sample #3 (Normal operation mode)

The EUT does not employ periodic transmission.

7.5 Continuous Transmission During an Alarm Condition

7.5.1 Regulation

15.231(a4) Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.

7.5.2 Result

Device: IDENTEC SOLUTIONS ILR® Transponder
Model: i-D2
Tested Samples: Sample #3 (Normal operation mode)

This section is not applicable to the EUT.

8 BANDWIDTH

Test Requirement: FCC CFR47, Part 15C

Test Procedure: ANSI C63.4:1992 Section 13.1.7

8.1 Regulation

15.231(c) The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

8.2 Calculation of 20 dB Bandwidth Limit

The 20 dB bandwidth limit = 0.0025 * 868.3 MHz = 2.17075 MHz ≈ 2,170 kHz

8.3 Test Equipment

Type	Manufacturer/ Model No.	Serial No.	Last Calibration	Next Calibration
Antenna	EMCC Test Fixture	none	n.a.	n.a.
Analyzer	Rohde & Schwarz ESAI-D ESMI-RF ESMI-B1	 833771/008 833827/002 832504/005	June 2000	June 2002

8.4 Test Procedure

ANSI C63.4-1992 Section 13.1.7 Occupied Bandwidth Measurements.
(...) The bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at either the fundamental frequency or first-order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical. Once the reference level is established, the equipment is conditioned with typical modulating signals to produce worst-case (i.e., the widest) bandwidth. (...) In order to measure the modulated signal properly, a resolution bandwidth that is small compared to the bandwidth required by the procuring or regulatory agency shall be used on the measuring instrument. However, the 6 dB resolution bandwidth of the measuring instrument shall be set to a value greater than 5% of the bandwidth requirements.(...)

8.5 Test Result

Device: IDENTEC SOLUTIONS ILR® Transponder
Model: i-D2
Tested Sample: Sample #2
Bandwidth setting of the analyzer: .....80 kHz [3 dB] corresponds with 120 kHz [6 dB]

The measured 20 dB bandwidth is: .....**984 kHz**

The EUT meets the requirements of this section.

Test Personnel: Wolfgang Döring
Test Date: 200-01-21

9 MISCELLANEOUS COMMENTS AND NOTES

None.

10 LIST OF ANNEXES

The following annexes are separated parts to this test report.

Description	Pages
Annex 1: Photographs of test setups	4
Annex 2: Photographs of equipment under test (EUT) external views	4
Annex 3: Photographs of equipment under test (EUT) internal views	9