RF ENERGY EMISSION TEST REPORT

OF THE

ALLFLEX Inc.

RF/ID Pocket Reader

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PREPARED FOR:

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303/449-4509

11/14/99
allflex1

FCC ID: NQY930009001

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SUMMARY

The testing was performed under the provisions of ANSI C63.4/1992 and the OATS was calibrated in accordance with ANSI C63.4/1992.

The ALLFLEX Inc. RF/ID Pocket Reader, is hereafter referred to as the UUT. The UUT, with test setup as described in the block diagram of Appendix II, **PASSES** all the radiated requirements of the FCC Part 15, Subpart C, Class B regulations, operating in the 134 KHz band in accordance with pp 15.209 for operation below 160 KHz.

The maximum field strength of the magnetic field emissions at 134.2 KHz of the ID Reader was 88 db verses a spec of 105 db since the measurement was performed at 3 meters. (a 40 db/decade correction factor was applied when going from 300 meters to 3 meters, yielding an 80 db increase in the 25 db limit at 300 meters).

The spurious radiated emissions of the UUT, which came closest to the limit in each of the test conditions are as follows, rounded to the nearest db:

FREQUENCY (MHz)	EMISSION LEVEL (dbμv/meter)	Polarization	MARGIN(db)	TABLES Appendix I
463.71	31	Horizontal	-15	1
480.88	24	Vertical	-22	2
51.51	11	Horizontal	-29	3
463.72	31	Vertical	-15	4
480.88	31	Vertical	-15	4

For more details, see Appendix I, Tables 1 - 7 and GRAPHS 1 - 4. A negative margin means that the emissions are under the specified limit. All other emissions from Tables 1 - 7, not listed above, were at least 16 db under the applicable limits.

The RF/ID Antenna is internal to the unit and not accessible to the user.

The UUT is completely powered by a battery which is not re-chargeable while installed in the UUT. Therefore, no conducted emissions measurements were required.

INFORMATION SUPPLIED TO THE USER

The manual contains a cautionary statement required by Section 15.21 of the FCC rules for an intentional radiator."

> ***CAUTION: Changes or modifications not expressly approved or authorized by the manufacturer may violate the compliance of this equipment to the Class B limits for a digital device and could, thereby, void the users authority to operate the equipment.***

The label on the outside of the equipment enclosure contains the FCC ID and the following text:

> **FCC ID:** NQY930009001
> This device complies with Part 15 of the FCC Rules.
> Operation is subject to the following two conditions:
> (1) this device may not cause harmful interference,
> and (2) This device must accept any interference
> received, including interference that may cause
> undesired operation.

ALLFLEX shall maintain the records listed in Section 2.938 of the FCC rules.

1.0 SCOPE AND OBJECTIVE OF TEST

To determine the degree of compliance of products to the Federal Communications Commission Part 15 Subpart C requirements for intentional radiators which limit emissions of Low Power Transmitter Devices pursuant to pp 15.209 through the certification process. At the same time the receiver is verified to meet pp 15.209 of the FCC rules.

2.0 UNIT TESTED

The FC/ID Pocker Reader Transceiver, manufactured by ALLFLEX Inc., 2820 Wilderness Place, Suite D, Boulder CO 80301, hereafter referred to as the UUT, is intended to identify the code of a passive transponder for visual observation and for manual transcription.

3.0 FACILITY REQUIREMENTS

3.1 Site Attenuation

The radiated testing described herein was accomplished on the METRUM OATS which is located at 4800 E. Dry Creek Road, Littleton, CO 80122. This site meets the requirements of FCC 47 CFR rules, Section 2.948. Refer to FCC File # 31040/SIT/1300F2 for a detailed description of the site. The test area is free of reflecting objects in an area as defined in Figure 1, Appendix III.

3.2 Instrumentation

Measurements/Radiated:

Polarad ESV Receiver, #6003594, calibrated 2/10/99, calibration due 2/10/2000.

Polarad ESH2 Receiver, #6003696, calibrated 2/10/99, calibration due 2/10/2000.

Rhode & Schwarz HFH2-Z2 Magnetic Field Active Loop Antenna, 10 KHz - 30 MHz.

Ailtech 94455-1 Biconical Antenna, 30 -200 MHz, Cal'd 8/3/99, Cal Due 8/3/2000.

Ailtech 96005 Log Periodic Antenna, 200 MHz - 1 GHz, Cal'd 8/3/99, Cal Due 8/3/2000.

Avantek UTC 10-220-1 25 db Preamp, #211.093, Calibrated 3/8/99, calibration due 3/8/2000.

4.0 SPURIOUS RADIATED TEST PROCEDURE AND RESULTS

4.1 Procedure

4.1.1 Setup of equipment on the test site, for detailed measurements, was according to Figure 2, Appendix III and the block diagram of Appendix II. **The ANSI C63.4/1992 measurement procedure was followed.**

4.1.2 The UUT was continuously reading the transponder during the measurements.

Two conditions were tested:

4.1.2.1 UUT Flat on its back, top at 0◦ with the measuring antenna - horizontally polarized and vertically polarized.

4.1.2.2 The UUT standing up with the keypad facing the measuring antenna for 0◦, which was horizontally and vertically polarized.

4.1.2.3 The UUT on its side, keypad facing the measuring antenna for 0◦.

4.1.3 Perform all measurements at 3 meters at the METRUM OATS. Adjust the antenna height between 1 - 4 meters and the UUT rotated to maximize the emissions during the survey. Perform a preliminary survey with each antenna and polarization (2 setups as in 4.1.2) while tuning the ESV receiver in the CISPR mode from 30 MHz - 1 GHz in accordance with ANSI C63.4-1992, Appendix D procedure. There were no interface cables to adjust.

4.1.4 At the conclusion of the preliminary survey for each antenna/polarization combination at the two combinations, the maximum field strength at each significant frequency found was recorded with the height of the antennas remotely and automatically varied between 1 and 4 meters off the ground plane. The orientation of the UUT which produced the maximum field strength was obtained by remotely rotating an automatic turntable and recording the angle as indicated in Tables 1 - 4. Only the frequencies which produced the highest emissions are reported.

4.0 SPURIOUS RADIATED TEST PROCEDURE AND RESULTS (cont)

4.1 Procedure (cont)

UUT orientation in Tables 1 & 2 is defined as follows:

TOP
0
LEFT 90 270 RIGHT
180
BOTTOM

4.1.7 The specified limit is 40 db from 30 - 88 MHz, 43.5 db from 88 - 216 MHz, 46 db from 216 - 960 MHz and 54 db from 960 - 1000 MHz.

Separation (Meters) is 3.

4.1.8 The radiated signal level, in dbμV vs. frequencies found, was determined from the correction factors found in Appendix II. The receiver reads directly in dbμV.

Emission level = ESV Receiver reading (dbμV) + antenna factor + cable loss - Preamp Gain.

4.1.9 Calculation

As an example in Table 1 of Appendix I, the 31 dbμV/m level at 463.71 MHz was calculated using the formula in paragraph 4.1.5. From Appendix II, the antenna factor is 17.1 db. From Appendix II, the cable loss is 2.1 db. The receiver reading was 36 dbμV. The preamp gain is 24.4 db.

Emission Level (463.7 MHz) = 36 + 17.1 + 2.1 - 24.4 = 30.8 dbμV/m.

There were no other factors involved such as external attenuators which would modify the calculations. The internal RF attenuation of the ESV receiver was kept at 10 db minimum, but the receiver reading takes this into account so it does not enter into the calculation.

4.2 Results

Preliminary tests showed the 4.1.2.2 combination was as noisy if not noisier than with the unit resting on its edge (4.1.2.3). Therefore only this vertical orientation was reported. The emissions when testing per the 4.1.2.1. orientation are also reported here.

See Appendix I, Tables 1 - 4 and GRAPHS 1 - 4.

Table 1/Graph 1: UUT on its back(horizontal) and the receive antenna horizontal. (condition 4.1.2.1)
Table 2/Graph 2: UUT on its back(horizontal) and the receive antenna vertical. (condition 4.1.2.1)
Table 3/Graph 3: UUT vertical and the receive antenna horizontal (condition 4.1.2.2)
Table 4/Graph 4: UUT vertical amd the receive antenna vertical (4.1.2.2)

See photographs of Exhibit 7.

The temperature at the time the final radiated measurements were taken was around 65 ◦F.

The measurement bandwidth was 120 KHz with the average detector selected from 30 MHz - 1 GHz.

5.0 RF ID Reader Transmit Magnetic Field Strength and Spurious Emissions From 134 KHz - 30 MHz.

5.1 PROCEDURE

5.1.1 Setup the UUT on the OATS as in pp 4.0 of this procedure in the following orientations:

5.1.1.1 UUT is horizontal on its side(the narrow edge).
5.1.1.2 UUT is standing up vertically.
5.1.1.3 UUT is horizontal on its back.

The photographs of Exhibit 7 showing the Rhode & Schwarz HFH2-Z2 magnetic loop are also applicable to these measurements. Perform measurements with each UUT orientation at a distance of 3 meters. with the center of the loop 1 meter above the ground plane and the plane of the loop parallel to the 0 degree orientation of the UUT as shown. The turntable is rotated 360◦ to maximize the level.

5.1.2 When measuring the maximum transmit field strength, set the ESH2 receiver detector function to "average" and the resolution bandwidth to 10 KHz. Repeat the measurement in "peak" mode with 10 KHz bandwidth.

5.1.3 When measuring the magnetic field strength of the spurious emissions, the CISPR (quasi-peak) detector with 9 KHz BW was used except as indicated in 15.209d in which case the average detector was used. All three orientations of 5.1.1 apply. Pay particular attention to the 134 KHz harmonics. Scan from 134 KHz to 30 MHz.

5.2 RESULTS

Refer to Appendix I, Tables 5 - 7. The UUT met the intentional and spurious limits. When the center of the transmit frequency was measured in "peak" mode, the level increased no more than 13 db above the average level in all instances.

Above the 4th harmonic there were no measurable emissions.

Appendix I

TABLE 1

Polarization: Horizontal
Antennas: AilTech Biconical & Log Periodic
Test Distance: 3 Meters
Product: ALLFLEX RF/ID Reader with the unit on its back.
Mode: Transmitting Continuously with data and carrier.
Date: 9/22/99; spurious radiated

degrees dbuv dbuv/m FCC 15.209

Freq(MHz)	Uncorrected	Azimuth	Correction Factor(db)	Corrected Level(db)	Margin (db)
51.51	25	0	-14	11	-29
65.5	28	0,360	-18	10	-30
120.19	23	270	-13	10	-34
154.6	24	246	-7	17	-27
223.27	36	272	-13	23	-23
240.46	36	272	-12	24	-22
257.6	34	292	-11	23	-23
274.8	31	290	-9	22	-24
291.27	28	298	-8	20	-26
326.32	29	272	-9	20	-26
343.5	36	260	-8	28	-18
360.65	36	260	-8	28	-18
377.84	36	260	-8	28	-18
395.01	34	275	-7	27	-19
412.2	34	67	-7	27	-19
429.36	35	80	-6	29	-17
446.53	36	84	-6	30	-16
463.71	36	93	-5	31	-15
480.88	33	95	-5	28	-18
515.27	31	60	-5	26	-20
532.42	27	93	-5	22	-24
549.59	28	93	-5	23	-23
566.79	27	250	-4	23	-23
583.99	26	272	-3	23	-23
601.12	23	231	-4	19	-27

Freq(MHz)	Uncorrected	Azimuth	Correction Factor(db)	Corrected Level(db)	Margin (db)
51.51	25	0	-14	11	-29
618.3	21	230	-3	18	-28

TABLE 2

Polarization: Vertical
Antennas: AilTech Biconical & Log Periodic.
Test Distance: 3 Meters
Product: ALLFLEX RF/ID Reader with the unit on its back.
Mode: Transmitting Continuously with data and carrier.
Date: 9/22/99; spurious radiated

	degrees	dbuv	dbuv/m	FCC 15.209
Freq(MHz)	Uncorrected	Azimuth	Correction Factor(db)	Corrected Level(db)	Margin (db)
34.33	24	278	-11	13	-27
51.51	30	86,248	-14	16	-24
65.5	29	0	-18	11	-29
85.95	28	275	-15	13	-27
223.27	26	360	-13	13	-33
240.46	26	0	-12	14	-32
257.6	25	360	-11	14	-32
274.8	23	172	-9	14	-32
412.26	26	175	-7	19	-27
429.36	26	175	-6	20	-26
446.54	29	0	-6	23	-23
480.88	29	0	-5	24	-22
515.23	26	238	-5	21	-25
532.43	23	38	-5	18	-28
549.6	23	38	-5	18	-28

Negative margin indicates emission is under the specified limit.

TABLE 3

Polarization: Horizontal
Antennas: AilTech Biconical & Log Periodic
Test Distance: 3 Meters
Product: ALLFLEX RF/ID Reader with the unit standing up.
Mode: Transmitting Continuously with data and carrier.
Date: 9/22/99; spurious radiated

	degrees	dbuv	dbuv/m	FCC 15.209
Freq(MHz)	Uncorrected	Azimuth	Correction Factor(db)	Corrected Level(db)	Margin (db)
51.51	25	0	-14	11	-29
65.5	24	0	-18	6	-34
223.27	28	296	-13	15	-31
240.46	27	325	-12	15	-31
257.6	26	294	-11	15	-31
274.8	25	308	-9	16	-30
291.25	24	295	-8	16	-30
309.14	21	240	-8	13	-33
360.66	24	281	-8	16	-30

Negative margin indicates emission is under the specified limit.

TABLE 4

Polarization: Vertical
Antennas: AilTech Biconical & Log Periodic, AH Systems Horn.
Test Distance: 3 Meters
Product: ALLFLEX RF/ID Reader with the unit standing up.
Mode: Transmitting Continuously with data and carrier.
Date: 9/22/99; spurious radiated

		degrees	dbuv	dbuv/m	FCC 15.209
Freq(MHz)	Uncorrected	Azimuth	Correction Factor(db)	Corrected Level(db)	Margin (db)
51.51	26	278	-14	12	-28
65.5	28	131	-18	10	-30
171.75	24	56	-8	16	-28
223.27	27	212	-13	14	-32
240.43	29	241	-12	17	-29
257.61	27	207	-11	16	-30
274.78	24	181	-9	15	-31
343.49	26	0	-8	18	-28
360.66	30	90,0	-8	22	-24
377.83	29	0	-8	21	-25
395.03	31	0	-7	24	-22
412.18	32	0	-7	25	-21
429.35	33	360	-6	27	-19
446.54	35	0	-6	29	-17
463.72	36	0	-5	31	-15
480.88	36	0,160	-5	31	-15
515.24	34	270	-5	29	-17
532.42	29	0	-5	24	-22
549.59	28	100	-5	23	-23
566.78	25	278	-4	21	-25
583.99	23	270	-4	19	-27
601.12	21	197	-3	18	-28
618.3	21	197	-3	18	-28

Negative margin means the emissions are under the specified limit.

FCC ID: NQY930009001

TABLE 5

Polarization: Vertical
Antennas: Rhode & Schwarz HFH2-Z2 Magnetic Loop
Test Distance: 3 Meters
Product: ALLFLEX RF/ID Tag Reader
Mode: Horizontal on narrow edge-intentional & spurious emissions
Date: 9/22/99

	degrees	dbuv	dbuv/m	FCC 15.209
Freq(MHz)	Uncorrected	Azimuth	Correction Factor(db)	Corrected Level(db)	Margin (db)*
.1342** a	59	0	20	79	-26
.2684 a	12	0	20	32	-67

*Using the 40 db/decade near field correction since the measurements were made at a distance of 3 meters.

**Center Frequency of the Intentional Transmit Signal. The peak level with a 10 KHz bandwidth was 13 db higher than the indicated average level.

a ESH2 receiver set to average detector, 10 KHz bandwidth.

TABLE 6

Polarization: Vertical
Antennas: Rhode & Schwarz HFH2-Z2 Magnetic Loop
Test Distance: 3 Meters
Product: ALLFLEX RF/ID Reader
Mode: Vertical Transmit(UUT Standing Up)
Transmit Level and Spurious Emission
Date: 9/22/99

degrees dbuv dbuv/m FCC 15.209

Freq(MHz)	Uncorrected	Azimuth	Correction Factor(db)	Corrected Level(db)	Margin (db)*
.1342 a**	68	0	20	88	-17
.2684 a	12	200	20	32	-67
.4026 a	30	0	20	50	-45

*Using the 40 db/decade near field correction since the measurements were made at a distance of 3 meters. The intentional transmit emission increased 12 db when the peak detector was selected.

**Center of Intentional Transmit Peak

a ESH2 receiver set to average detector, 10 KHz bandwidth.

TABLE 7

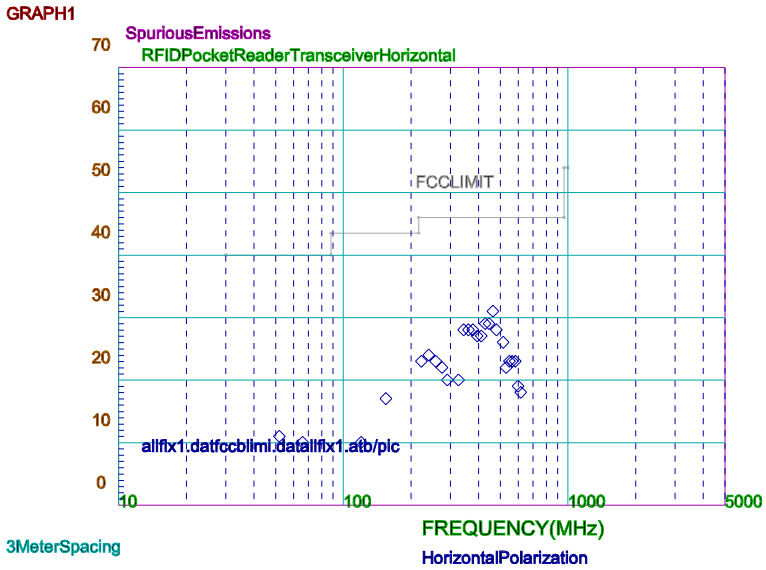
Polarization: Vertical
Antennas: Rhode & Schwarz HFH2-Z2 Magnetic Loop
Test Distance: 3 Meters
Product: Wand Tag Reader
Mode: Horizontal (UUT lying down on its back)
Transmit Level and spurious
Date: 9/22/99

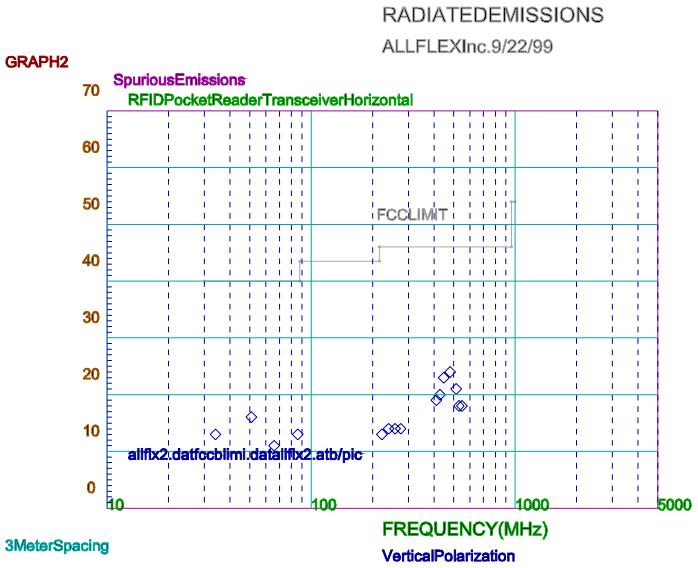
degrees dbuv dbuv/m FCC 15.209

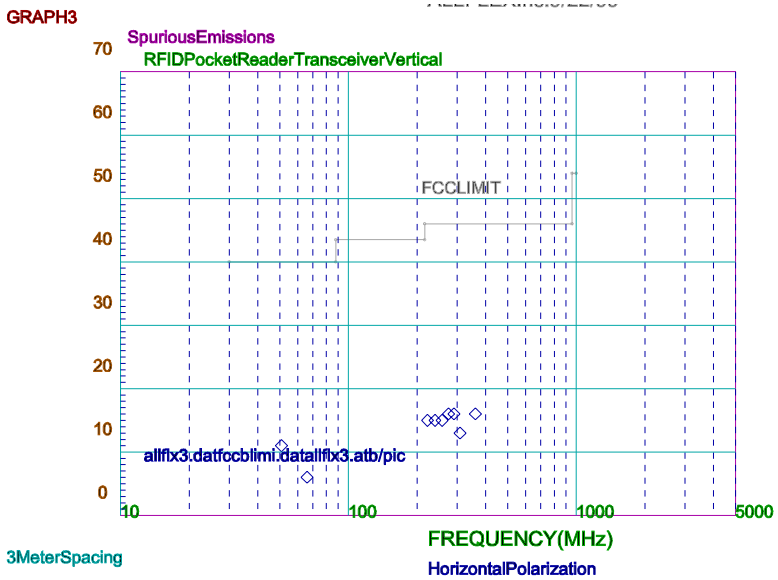
Freq(MHz)	Uncorrected	Azimuth	CorrectionFactor(db)	Corrected Level(db)	Margin (db)*
.1342 a**	68	138	20	88	-17
.2684 a	12	140,270	20	32	-67
.4026 a	31	132	20	51	-44

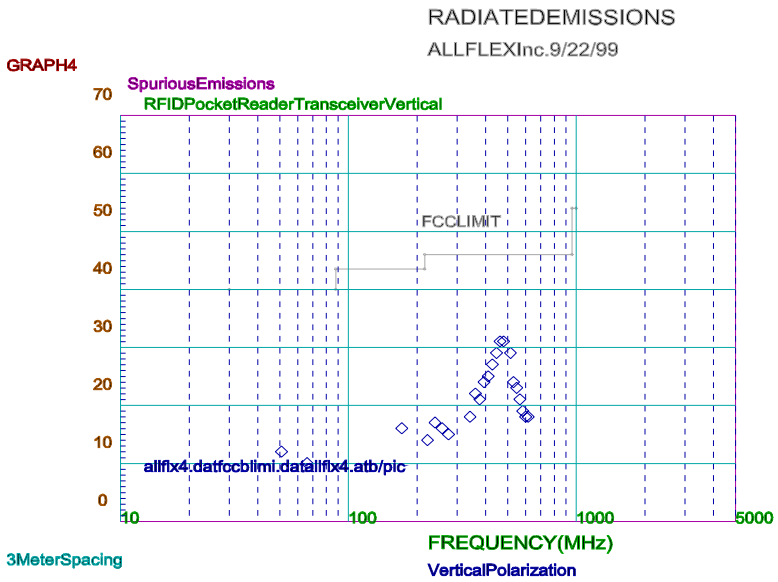
*Using the 40 db/decade near field correction since the measurements were made at a distance of 3 meters. The intentional transmit emission increased 12 db when the peak detector was selected.

**Center of Intentional Transmit Peak
a ESH2 receiver set to average detector, 10 KHz bandwidth.


GRAPH1
SpuriousEmissions
RFIDPocketReaderTransceiverHorizontal
70
60
50
40
30
20
10
0
FCCLIMIT
allfix1.datfccblimi.dataallfix1.atb/pic
10
100
1000
5000
FREQUENCY(MHz)
3MeterSpacing
HorizontalPolarization
FieldStrength(db


RADIATEDEMISSIONS
ALLFLEXInc.9/22/99
GRAPH2
SpuriousEmissions
RFIDPocketReaderTransceiverHorizontal
70
60
50
40
30
20
10
0
FCCLIMIT
allfix2.datfccblimi.dataallfix2.atb/pic
10
100
1000
5000
FREQUENCY(MHz)
3MeterSpacing
VerticalPolarization
FieldStrength(dbuv/m)


GRAPH3
SpuriousEmissions
RFIDPocketReaderTransceiverVertical
70
60
50
40
30
20
10
0
FCCLIMIT
allfix3.datfccblimi.datallfix3.atb/pic
10
100
1000
5000
FREQUENCY(MHz)
3MeterSpacing
HorizontalPolarization
FieldStrength(db


RADIATEDEMISSIONS
ALLFLEXInc.9/22/99
GRAPH4
SpuriousEmissions
RFIDPocketReaderTransceiverVertical
70
60
50
40
30
20
10
0
FCCLIMIT
allflx4.datfccblimi.dataflflx4.atb/pic
10
100
1000
5000
FREQUENCY(MHz)
3MeterSpacing
VerticalPolarization
FieldStrength(dbuv/m)

Appendix II

3 Meter Spacing/ AilTech Antennas 8/3/99

FREQ. (MHz)	Antenna Factor (db)	Preamp Gain(db)	Cable Loss(db)	Total Factor
30	13	25.3	.5	-11.8
35	13.3	25.3	.5	-11.5
40	13.3	25.2	.6	-11.3
45	12	25.2	.7	-12.5
50	10.7	25.2	.8	-13.7
55	9.2	25.2	.8	-15.2
60	7.8	25.2	.8	-16.6
65	6.4	25.2	.8	-18.0
70	5.8	25.2	.8	-18.6
75	6.9	25.1	.9	-17.3
80	8.3	25.1	.9	-15.9
85	9.6	25.1	.9	-14.6
90	10.8	25.1	.9	-13.4
95	10.9	25.1	1	-13.2
100	10.6	25.1	1	-13.5
105	10.8	25.1	1	-13.3
110	10.6	25.1	1	-13.5
115	10.2	25	1	-13.8
120	10.8	25	1	-13.2
125	12	25	1	-12.0
130	12.8	25	1.1	-11.1

135	13.8	25	1.1	-10.1
140	15.1	24.9	1.1	-8.7
145	15.9	24.9	1.1	-7.9
150	16.3	24.9	1.1	-7.5
155	16.8	24.9	1.2	-6.9
160	16.7	24.9	1.2	-7.0

Avantek UTC10-220-1
106' of LDF5-50A + 20' of FSJ1 + 20' of FSJ4

3 Meter Spacing/Ailtech Antennas 8/3/99

FREQ. (MHz)	Antenna Factor (db)	Preamp Gain(db)	Cable Loss(db)	Total Factor
165	16.1	24.9	1.2	-7.6
170	15.7	24.9	1.2	-8.0
175	15	24.8	1.2	-8.6
180	13.6	24.8	1.2	-10.0
185	13.5	24.8	1.2	-10.1
190	14	24.8	1.3	-9.5
195	16.6	24.8	1.3	-6.9
200	16.4	24.8	1.3	-7.1
200	11.2	24.8	1.3	-12.3
210	11.0	24.7	1.3	-12.4
220	10.2	24.7	1.3	-13.2
230	11.0	24.7	1.4	-12.3
240	11.4	24.6	1.4	-11.8
250	11.9	24.6	1.4	-11.3
260	12.3	24.6	1.4	-10.9
270	13.3	24.5	1.5	-9.7
280	13.9	24.5	1.5	-9.1
290	14.4	24.5	1.5	-8.6
300	15.3	24.4	1.6	-7.5
310	14.4	24.4	1.6	-8.4
320	13.9	24.4	1.6	-8.9

330	14.3	24.4	1.7	-8.4
340	14.6	24.4	1.7	-8.1
350	14.6	24.4	1.7	-8.1
360	14.5	24.4	1.8	-8.1
370	14.5	24.3	1.8	-8.0
380	14.8	24.3	1.8	-7.7
390	15	24.3	1.9	-7.4

Avantek UTC 10-220-1
106' of LDF5-50A + 20' of FSJ1 + 20' of FSJ4

3 Meter Spacing/Ailtech Antennas 8/3/99

FREQ. (MHz)	Antenna Factor (db)	Preamp Gain(db)	Cable Loss(db)	Total Factor
400	15.6	24.3	1.9	-6.8
425	15.6	24.3	1.9	-6.7
450	16.5	24.4	2.1	-5.8
475	17.6	24.5	2.1	-4.8
500	18.1	24.5	2.2	-4.2
525	17.7	24.6	2.2	-4.7
550	17.8	24.6	2.3	-4.5
575	18.5	24.6	2.4	-3.7
600	18.7	24.6	2.5	-3.4
625	19.1	24.7	2.5	-3.1
650	19.9	24.7	2.6	-2.2
675	20.8	24.7	2.6	-1.3
700	20.8	24.7	2.7	-1.2
725	20.6	24.8	2.7	-1.5
750	20.5	24.8	2.8	-1.5
775	20.7	24.8	2.9	-1.2
800	21.3	24.8	2.9	-0.6
825	22.1	24.7	2.9	0.3
850	22.9	24.7	3	1.2
875	23	24.6	3	1.4

900	22.8	24.6	3.1	1.3
925	22.8	24.5	3.1	1.4
950	23.3	24.5	3.1	1.9
975	23.9	24.3	3.2	2.8
1000	24.5	24.2	3.2	3.5

Avantek UTC 10-220-1
106' of LDF5-50A + 20' of FSJ1 + 20' of FSJ4

Appendix III

Table of Oscillator Frequencies

RF/ID Tag Reader: 17.1776 MHz

UUT BLOCK DIAGRAM