FCC ID: MJCPERMALOG

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TTI - P-G 009 / 98-00
TTI - P-G 089 / 94-50

E M I S S I O N -- T E S T R E P O R T

Testreport file no. : **T 19197-1-00 MN** Date of issue : July 30, 2000

Model : Transmitter for detecting leaks in water distribution systems.

Type : Permalog Logger I

Applicant : Palmer environmental Ltd.

Manufacturer : Palmer environmental Ltd.

Licence holder : Palmer environmental Ltd.

Address : TY COCH HOUSE, CWMBRAN

GWENT, NP44 3AW, UK

Test result accrdg. to the regulation(s) at page 3 : **POSITIV**

This testreport with appendix consists of **52** pages.
The testresult only responds to the tested sample. It is not allowed to copy this report even partly without the allowance of the testlaboratory.

DIRECTORY

FCC ID: MJCPERMALOG

T E S T R E G U L A T I O N S

The tests were performed according to following regulations :

o - EN 50081-1 / 2.1991
o - EN 50081-2 / 7.1993

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o - EN 55011 / 3.1991 — o - Group 1 — o - Group 2; o - class A — o - class B

o - EN 55014 / 4.1993 — o - Household appliances and similar; o - tools; o - Semiconductor devices

o - EN 55014 / A2:1990
o - EN 55104 / 5.1995 — Category:

o - EN 55015 / A1:1990
o - EN 55015 / 12.1993

o - EN 55022 / 5.1995 — o - class A — o - class B

o - prEN 55103-1 / 3.1995
o - prEN 50121-3-2 / 3.1995
o - EN 60601-1-2 / 4.1994

o - VCCI — o - class 1 — o - class 2

■ - Part 90 Subpart I (90.217)

ADDRESS OF THE TEST LABORATORY

■ - **MIKES BABT PRODUCT SERVICE GmbH**
Ohmstrasse 2-4
D - 94342 Strasskirchen

o - _____
_____
_____

ENVIRONMENTAL CONDITIONS

Temperature: 15-35 ° C

Humidity 45-60 %

Atmospheric pressure 860-1060 mbar

POWER SUPPLY SYSTEM UTILIZED

Power supply system : Battery Unom = 3 V DC

STATEMENT OF MEASUREMENT UNCERTAINTY

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities that can account for a nominal measurement error of ±4dB. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

SHORT DESCRIPTION OF THE EQUIPMENT UNDER TEST (EUT)

Transmitter for detecting leaks in water distribution systems.
The EuT transmits to the receiver 1 KHz to indicates no leak and 2 KHz to indicates Leak.
Number of received/tested samples: **1 / 1**

DEFINITIONS FOR SYMBOLS USED IN THIS TEST REPORT

■ - Black box indicates that the listed condition, standard or equipment is applicable for this Report.
o - Blank box indicates that the listed condition, standard or equipment was not applicable for this Report.

MEASUREMENT PROTOCOL FOR FCC, VCCI AND AUSTEL

Test Methodology

Conducted and radiated emission testing is performed according to the procedures in International Special Committee on Radio Interference (CISPR) Publication 22 (1993), European Standard EN 55022 and Australian Standard AS 3548 (which are based on CISPR 22).

The Japanese standard, "Voluntary Control Council for Interference (VCCI) by Data Processing Equipment and Electronic Office Machines, Technical Requirements" is technically equivalent to CISPR 22 (1993). For official compliance, a conformance report must be sent to and accepted by the VCCI.

In compliance with FCC Docket 92-152, "Harmonization of Rules for Digital Devices Incorporate International Standards", testing for FCC compliance may be done following the ANSI C63.4-1992 procedures and using the FCC limits or the CISPR 22 Limits.

Measurement Error

The test system for conducted emissions is defined as the LISN, tuned receiver and coaxial cable. The test system for spurious emissions is defined as the antenna, the pre-amplifier, the tuned receiver and the coaxial cable. These test systems have an expected error of ±3 dB. The equipment comprising the test systems are calibrated on an annual basis.

Justification

The Equipment Under Test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral into it’s characteristic impedance or left unterminated. When appropriate, the cables are manually manipulated with respect to each other to obtain maximum emissions from the unit.

General Standard Information

The test methods used comply with CISPR Publication 22 (1993), EN 55022 (1987) and AS 3548 (1992) - "Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment" and with ANSI C63.4-1992 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz."

For detailed description of each measurement please refer to section testresults.

DISCOVERY OF WORST CASE MEASUREMENT CONDITION:

The Permalog Logger is designed for the operation on the fixed transmitter frequency of approx. 463.9 MHz.
To find out the worst case conditions for the complete measurement the following tests have been performed:

- Measurement of the radiated fieldstrength of the operating frequency measured in unmodulated transmission mode in the specified channel. This measurement have been performed in order to find out the maximum transmitted fieldstrength of the EuT.
- Measurement of the radiated spurious emissions and frequency error measured in unmodulated transmission mode in the specified channel. This measurement have been performed in order to find out the maximum spurious emissions of the Eut.

- Measurement of the bandwidth under extreme conditions measured in modulated transmission mode in the specified channel.

Based on this testresults, the measurements have been performed completely on the specified channel. This testresults are documented in the following sections of the testreport.

TESTRESULT

CONDUCTED EMISSIONS - 10/150 kHz - 30 MHz

■ **- Test not applicable**

Testlocation :
o - Shielded room no. 1
o - Shielded room no. 2
o - Shielded room no. 3
o - Shielded room no. 4
o - Shielded room no. 5
o - Shielded room no. 6
o - Shielded room no. 7
o - Anechoic chamber
o - Full compact chamber

For TEST EQUIPMENT USED please refer to ATTACHMENT B: _____

Description of Measurement

The final level, expressed in dBµV, is arrived at by taking the reading directly from the EMI receiver. This level is compared directly to the FCC Limit or to the CISPR limit, which is equivalent to the Australian AS 3548 limit.
To convert between dBµV and µV, the following conversions apply:

dBµV = 20(log µV)
µV = Inverse log(dBµV/20)

Conducted emissions on the 50 Hz and/or 60 Hz power interface of the EUT are measured in the frequency range of 150 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasipeak detection, and a Line Impedance Stabilization Network (LISN), with 50Ω/50 µH (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 centimeters above the floor and is positioned 40 centimeters from the vertical ground plane (wall) of the screen room. If the minimum passing margin appears to be less than 20 dB with a peak mode measurement, the emissions are remeasured using a tuned receiver with quasipeak and average detection and recorded on the data sheets.

Testresult

The requirements are **O - MET** **O - NOT MET**

Min. limit margin _____ dB at _____ MHz

Max. limit exceeding _____ dB at _____ MHz

Remarks: The EuT is battery powered.

SPURIOUS EMISSION

Spurious emissions from the EUT are measured in the frequency range of 9 kHz to 30 MHz using a tuned receiver and a shielded loop antenna. The antenna was positioned 3, 10 or 30 meters horizontally from the EUT. Measurements have been made in all three orthogonal axes and the shielded loop antenna was rotated to locate the maximum of the emissions.

Spurious emissions from the EUT are measured in the frequency range of 30 MHz to 10 times the highest used frequency using a tuned receiver and appropriate broadband linearly polarized antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasipeak detection and measurements above 1000 MHz are made with a 1 MHz/6 dB bandwidth and peak detection, remeasurement of results which may be critical will be repeated in average mode. Table top equipment is placed on a 1.0 X 1.5 meter non-conducting table 80

centimeters above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. Interface cables that are closer than 40 centimeters to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimeters from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screen room located outside the test area. The antenna was positioned 3, 10 or 30 meters horizontally from the EUT. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 meters, measurement scans are made with both horizontal and vertical antenna polarizations and the EUT are rotated 360 degrees.

SPURIOUS EMISSION (MAGNETIC FIELD) 10 kHz - 30 MHz

■ **- Test not applicable**

o - in a shielded room
o - at a non - reflecting open-site
and
o - in a testdistance of 3 meters.
o - in a testdistance of 30 meters.

For TEST EQUIPMENT USED please refer to ATTACHMENT B:

Description of Measurement

The final level, expressed in dBµV/m, is arrived at by taking the reading from the EMI receiver (Level dBµV) and adding the antenna correction factor and cable loss factor (Factor dB) to it. This result then has to be compared with the relevant FCC limit.

Example:

Frequency (MHz)	Level (dBµV)	+	Factor (dB)	=	Level (dBµV/m)	Limit (dBµV/m)	=	Delta (dB)
1.705	5	+	20	=	25	30	=	5

Testresult in detail:

Frequency MHz	L: QP dBµV	L: AV dBµV	Correct.	L: QP dBµV/m	L: AV dBµV/m	Limit dBµV/m

The requirements are **O - MET** **O - NOT MET**

Min. limit margin _____ dB _____ MHz

Max. limit margin _____ dB _____ MHz

Remarks: NOT APLLICABLE

SPURIOUS EMISSIONS (electric field) 30 MHz - 1000 MHz

o **- Test not applicable**

■ - Open-site 1
o - Open-site 2
■ - 3 meters
o - 10 meters
o - 30 meters

For TEST EQUIPMENT USED please refer to ATTACHMENT B: A5

Description of Measurement

The final level, expressed in dBµV/m, is arrived by taking the reading from the EMI receiver (Level dBµV) and adding the correction factors and cable loss factor (Factor dB) to it. This is done automatically in the EMI receiver, where the correction factors are stored. This result then has the FCC or CISPR limit subtracted from it to provide the Delta which gives the tabular data as shown in the data sheets at page 24 - 25. The CISPR 22 limit is equivalent to the Australian AS 3548 limit.

Example:

Frequency (MHz)	Level (dBµV)	+	Factor (dB)	=	Level (dBµV/m)	Limit (dBµV/m)	=	Delta (dB)
719	75	+	32.6	=	107.6	110	=	-2.4

Testresult in detail:

Frequency MHz	L: Peak dBµV	L: QP dBµV	L: AV dBµV	Correct	L: Peak dBµV	L: QP dBµV/m	L: AV dBµV/m	Limit dBµV/m
331.37	27.95	23.95	20.95	21.45	49.4	45.4	42.4	88.2
397.64	13.25	9.25	7.25	22.3	35.5	31.5	29.5	88.2
927.84	22.0	17.99	15.0	33.3	54.3	51.3	48.3	88.2

Testresult

The requirements are	■ **- MET**			**O - NOT MET**	
Min. limit margin	32.6	dB	at	927.84	MHz
Max. limit exceeding	_____	dB	at	_____	MHz

Remarks: The limits are met.

SPURIOUS EMISSION 1 GHz - 18 GHz

o **- Test not applicable**

Testlocation :
o - Open-site 1
o - Open-site 2
■ - Anechoic chamber
o - Full compact chamber

o - 1 meters
■ - 3 meters
o - 10 meters

For TEST EQUIPMENT USED please refer to ATTACHMENT B: SER3

Description of Measurement

The final level, expressed in dBµV/m, is arrived by taking the reading from the Spectrumanalyzer in dBµV and adding the correction factors of the test setup incl. cables.

Example of the correction value at 1.8 GHz

Level reading at 1.8 GHz	Correction EMCO 3115	correction Amplifier AWT 4534 + cable	Correction factor (summarized)	corrected level
56 dBµV	+27.3 dB	-41.2 dB	-15.8 dB	42.1 dBµV/m

Testresult

The requirements are ■ **- MET** **O - NOT MET**

Min. limit margin 26.8 dB at 1.392 GHz

Max. limit exceeding _____ dB at _____ GHz

Remarks: The limits are met. The measurement has been performed in Peak-mode for 1 GHz to 4.7 GHz. For critical results, the measurement would be repeated in average mode.

Testresult in detail:

Frequency GHz	**L: Peak dBµV**	**L: AV dBµV**	**Correct.**	**L: Peak dBµV/m**	**L: AV dBµV/m**	**Limit dBµV/m**
1.392	76.8	--	-15.4	61.4	31.4	88.2
1.856	61	--	-13.1	47.9	--	88.2
2.260	55	--	-11.1	43.9	--	88.2

FIELD STRENGTH OF THE FUNDAMENTAL WAVE

o **- Test not applicable**

■ - Open-site 1
o - Open-site 2
■ - 3 meters
o - 10 meters
o - 30 meters

For TEST EQUIPMENT USED please refer to ATTACHMENT B: CPR2

Description of Measurement

The final level, expressed in dBµV/m, is arrived by taking the reading from the EMI receiver (Level dBµV) and adding the correction factors and cable loss factor (Factor dB) to it. This is done automatically in the EMI receiver, where the correction factors are stored. This result then has the FCC or CISPR limit subtracted from it to provide the Delta which gives the tabular data as shown in the data sheets at page 24 - 25. The CISPR 22 limit is equivalent to the Australian AS 3548 limit.

Example:

Frequency (MHz)	Level (dBµV)	+	Factor (dB)	=	Level (dBµV/m)	-	Limit (dBµV/m)	=	Delta (dB)
315	45	+	22.5	=	67.5	-	74.3	=	-6.8

Testresult in detail:

Frequency GHz	L: Peak dBµV	L: QP dBµV	L: AV dBµV	Correct	L: Peak dBµV/m	L: QP dBµV	L: AV dBµV/m	Limit dBµV/m
463.9	72.4	67.4	63.4	24.76	97.16	92.16	88.16	118.2

Testresult

The requirements are ■ **- MET** **O - NOT MET**

Min. limit margin 26.0 dB at 463.9 MHz

Max. limit exceeding _____ dB at _____ MHz

Remarks: The limits are met.

CONDUCTED POWER OF THE FUNDAMENTAL WAVE MEASURED ON THE ANTENNA TERMINALS

■ **- Test not applicable**

Testlocation :
o - Shielded room no. 1
o - Shielded room no. 2
o - Shielded room no. 3
o - Shielded room no. 4

o - Shielded room no. 5
o - Shielded room no. 6
o - Shielded room no. 7
o - Anechoic chamber
o - Full compact chamber
o - Climatic test chamber VLK

For TEST EQUIPMENT USED please refer to ATTACHMENT B:

Description of Measurement

The conducted power of the fundamental wave measured on the antenna terminals in a climatic test chamber. The antenna jack was connected to the input of a communication test receiver. The internal batteries have been removed also and a variable DC power supply was used instead. The measurements have been made with the EUT unmodulated. During the test the supply voltage and the temperature were varied and applied simultaneously. The lower supply voltage was given by the manufacturer. In case the equipment was switching off before, the switch off voltage was used instead.

Testresult

The requirements are **O - MET** **O - NOT MET**

Frequency range of equipment								
Tempera-ture/°C	DC supply voltage/V	Power/dBm	Power/dBm	Power/dBm	Power/dBm	Power/dBm	Power/dBm	Power/dBm
-30								
-20								
-10								
0								
+10								
+20								
+30								
+40								
+50								

Remarks: NOT APPLICABLE

FREQUENCY ERROR

o **- Test not applicable**

Testlocation :
o - Shielded room no. 1
o - Shielded room no. 2
o - Shielded room no. 3
o - Shielded room no. 4
o - Shielded room no. 5
o - Shielded room no. 6
o - Shielded room no. 7
o - Anechoic chamber
o - Full compact chamber
■ - Climatic test chamber VLK

For TEST EQUIPMENT USED please refer to ATTACHMENT B: FE

Description of Measurement

The frequency error was measured with antenna jack in a climatic test chamber. The antenna jack was connected to the input of a communication test receiver. The internal batteries have been removed also and a variable DC power supply was used instead. The measurements have been made with the EUT unmodulated. During the test the supply voltage and the temperature were varied and applied simultaneously. The lower supply voltage was given by the manufacturer. In case the equipment was switching off before, the switch off voltage was used instead. The frequency error is defined as the deviation of the transmitting frequency from the nominal frequency.

Testresult:

The requirements are ■ **- MET** **O - NOT MET**

Frequency range of equipment								
Tempera-ture/°C	DC supply voltage/V	Frequency error/kHz	Frequency error/kHz	Frequency error/kHz	Frequency error/kHz	Frequency error/kHz	Frequency error/kHz	Frequency error/kHz
-30	3.6	-0.9						
	3.0	-1.4						
-20	3.6	0.3						
	3.0	-0.1						
-10	3.6	1.5						
	3.0	0.8						
0	3.6	2.0						
	3.0	1.8						
+10	3.6	2.0						
	3.0	1.7						
+20	3.6	1.3						
	3.0	1.2						
+30	3.6	0.5						
	3.0	0.4						
+40	3.6	-0.2						
	3.0	-0.3						
+50	3.6	-0.4						
	3.0	-0.5						

Remarks: The most strict limit for this frequency range is: 23.2 kHz
(0.005% of 463.9 MHz)

KEEPING THE REQUIREMENTS OF THE EMISSION MASK

o **- Test not applicable**

Testlocation :
o - Shielded room no. 1
o - Shielded room no. 2
o - Shielded room no. 3
o - Shielded room no. 4
o - Shielded room no. 5
o - Shielded room no. 6
o - Shielded room no. 7
o - Anechoic chamber
o - Full compact chamber
■ - Climatic test chamber VLK

For TEST EQUIPMENT USED please refer to ATTACHMENT B: EM

Description of Measurement

The keeping of the requirements of the emission mask was measured with an antenna jack in Climatic test chamber.The antenna jack was connected to the input of a spectrum anlayzer. The spectrum analyzer was set up as following:

- video and resolution bandwidth: 10 kHz
- attenuation: automatic, low noise
- center frequency: nominal transmit frequency
- frequency span: 100 kHz

The reference level was set to the maximum value of the unmodulated carrier. The internal batteries have been removed also and a variable DC power supply was used instead. The measurements have been made with a modulation frequency and voltage accdg. to the specification of the manufacturer. During the test the supply voltage and the temperature were varied and applied simultaneously. The lower supply voltage was given by the manufacturer. In case the equipment was switching off before, the switch off voltage was used instead.

Testresult

The requirements are ■ **- MET** **O - NOT MET**

The ***requirements*** are as following:
Attenuation on any frequencies removed from the transmit frequency
between 50 and 100 % of the authorized bandwidth: at least 25 dB
between 100 and 250 % of the authorized bandwidth: at least 35 dB
more than 250 % of the authorized bandwidth: see spurious emissions

The following table is showing the minimal margin to the required attenuations:

Temperatur /°C	DC supply voltage/V	±50-100% [dB]	±100-250% [dB]	±50-100% [dB]	±100-250% [dB]	±50-100% [dB]	±100-250% [dB]
-30	3.6	> 5	> 10				
	3.0	> 5	> 10				
-20	3.6	> 5	> 10				
	3.0	> 5	> 10				
-10	3.6	> 5	> 10				
	3.0	> 5	> 10				
0	3.6	> 5	> 10				
	3.0	> 5	> 10				
10	3.6	> 5	> 10				
	3.0	> 5	> 10				
20	3.6	> 5	> 10				
	3.0	> 5	> 10				
30	3.6	> 5	> 10				
	3.0	> 5	> 10				
40	3.6	> 5	> 10				
	3.0	> 5	> 10				
50	3.6	> 5	> 10				
	3.0	> 5	> 10				

Remarks: The limit is kept. The attenuation is related to the un-

modulated carrier. For plot see page A5-A22.

EQUIPMENT UNDER TEST

Operation - mode of the EUT.:
The equipment under test was operated during the measurement under following conditions:

o - Standby

o - Testprogram (H - Pattern)

o - Testprogram (color bar)

o - Testprogram (customer specific)

■ - Transmit (unmodulated)(for radiated measurements and frequency error)

■ - Transmit (modulated)(for bandwidth under extreme conditions measurements)

Configuration of the equipment under test: see appendix
Following periphery devices and interface cables were connected during the measurement:

o - _____ Type : _____

o - _____ Type : _____

o - _____ Type : _____

o - _____ Type : _____

o - _____ Type : _____

o - _____ Type : _____

o - unshielded power cable

o - unshielded cables

o - shielded cables MPS.No.:

o - customer specific cables (wireless microphone)

■ - no cables

o - _____

S U M M A R Y

GENERAL REMARKS:

FINAL JUDGEMENT:

The requirements according to the technical regulations and tested operation modes are

■ - met.

o - **not** met.

The equipment under test

■ - **Fulfills** the general approval requirements cited on page 3.

o - **Does not** fulfill the general approval requirements cited on page 3.

Date of receipt of test sample : accdg. to storage record

Testing Start Date : December 08, 1999

Testing End Date : January 18, 2000

- MIKES BABT PRODUCT SERVICE GmbH -

Günter Mikes
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FCC ID: MJCPERMALOG