CATERPILLAR®

Abstract

AU:Plumier HL

Date: 09/05/2002

Job Director:

SUBJ: **FCC Part 15 EMC Test Report for the Transponder Reader Module, 218-0404-01**

Abs: This report documents the FCC Part 15 EMC test results for the Transponder Reader Module, 218-0404-01

Keys: EMC, Transponder Reader Module, 218-0404-01

Retention: Indefinite

NOTE: Documents with "5 years" as the retention period will only be available in electronic format (no paper copy) and will be automatically deleted 5 years from the date of the document. Effective June 30, 2001, **ALL** documents must be submitted in electronic format (no paper copy).

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Technical Document

Date: 09/05/2002

Author: Plumier HL

Charge No:

Test Period: 09/12/2002 to 9/21/2002

Source Div:

SUBJ: FCC Part 15 EMC Test Report for the Transponder Reader Module, 218-0404-01

Introduction:

The Transponder Reader Module, 218-0404-01 was tested at the Caterpillar EMC Test Facility (FCC Registration # 99460), at the Pioneer Park building. The purpose of the test was to demonstrate compliance with FCC EMC requirements.

Objectives:

The Transponder Reader Module, 218-0404-01 was tested at the Caterpillar EMC Test Facility at the Pioneer Park building. The objectives of this report are to demonstrate compliance with FCC EMC requirements, and to provide documentation of the test results.

Conclusions:

1. The Transponder Reader Module, 218-0404-01 met the requirements of FCC 15.209 & FCC 15.109 for a Class A device. Since the device under test was battery operated, FCC 15.207 was not required (see FCC15.207 (d))

Plumier HL
Div 726-05, EMC Test Facility, PPK
309-578-3244

Note:

Pages 20 – 23 were modified on 11/1/02 by the author in the following ways:

1) Graph titles were changed to reflect correct frequency range,
2) Graph titles were changed from "FCC Part 15B Intentional Radiator" to "FCC Part 15C Intentional Radiator".

These changes were requested by Bill Lusa in the e-mail shown on the next page.

Gregory H. Gipp
10/31/2002 08:00 AM

To: Howard L. Plumier cc: "Bill Lusa", J Martin Hadank
Subject: Request to modify FCC for TRM (218-0404) - file #674

Caterpillar: Confidential Green
Retain Until: 11/30/2002
Retention Category: G90 - Information and Reports

Howard,

I spoke with Bill yesterday and he said that the person processing the FCC certification for TRM requested that two changes (described below) be made to the FCC report that you issued on the TRM.

Can you please take a look at this request. If it makes sense could you make the requested modifications and send the report back to me and Bill?

Thanks,

Greg
4-4128

"Bill Lusa" <bill@w-app.com>

"Bill Lusa"
<bill@w-app.com>
10/30/02 03:08 PM

To: "Gregory H. Gipp"

Subject: Test report

Caterpillar: Confidential Green
Retain Until: 11/30/2002
Retention Category: G90 - Information and Reports

Notes from the reviewer of our file:

The intentional radiator plots say that they are "Far Field Radiated Emissions 30MHz to 1GHz." However, the data is from 10kHz to 30MHz. Please correct the title of the plots to reflect the frequency range of the emissions tested.

The plots also state 15B intentional radiator. Please correct to state 15C intentional radiator.

Test Plan

EMC Test Plan

Transponder Reader Module

218-0404 chg 01

Version 1.1

7 August 2002

Greg Gipp

1 Device Under Test (DUT)

1.1 Description

1.1.1 Functional Description

1.1.1.1 Overview

The TRM (Transponder Reader Module) is an intelligent sensor which uses RFID (134.2 KHz) technology to communicate with a transponder that is embedded in the electronic ignition key via a separate exciter coil. The TRM communicates with a host ECM (Electronic Control Module) via the CAN datalink using an encrypted J1939 protocol. Upon reception of a request for key ID from the host ECM, the TRM energizes the exciter coil for 50 ms, then reads the 128 bit code that the key transmits. The TRM checks the code to ensure that the received code is from a TIRIS Read-Only Low Frequency transponder. It does not check to see if the key is authorized, but it does use error checking and CRC (Cyclic Redundancy Check) to make sure that the received data is valid, and it checks the format of the signal to make sure that it is in the correct form for such a transponder.

If the received ID is from a valid TIRIS Read-Only transponder, then the 64 bit ID is encrypted and sent via J1939 back to the host computer. If no transponder is present when the key read sequence is initiated, or if a non-TIRIS, or a TIRIS Read/Write transponder is detected, a second attempt to read will be made. If there still is no Read-Only LF TIRIS chip present, then a third read attempt will be made. If there still is no valid R/O LF TIRIS transponder present, then the transponder sends a message to the host ECM via J1939 indicating that it did not find a valid R/O LF TIRIS chip. If it does recognize a R/O LF TIRIS chip, no matter which attempt, it will encrypt that value and send it back to the host ECM via J1939. The TRM will then go back to the dormant state until it receives another request to read the transponder.

1.1.1.2 Operating Modes

The TRM has only one operating mode in normal operation, however given that the vast majority of the time that it is powered it is in the "steady state", or *dormant* mode, we have artificially created two "test" modes to facilitate testing of relevant functions and parameters. These are:

1. Constant Key Read (CKR)
2. Constant RF (CRF)

In the Constant Key Read (CKR) mode the TRM does not accept requests from a host ECM for key reads. Instead it internally initiates a key read sequence every 500 ms. If a valid LF R/O TIRIS transponder is detected, the 64 bit ID is encrypted and sent via J1939 to the host ECM. If none is encountered, a second, and third (if needed) attempt is made to read such a transponder. If none are detected, then a message is sent via J1939 that no valid key was encountered. This mode is used primarily for EMC susceptibility testing.

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Author [signature]
Date 9/5/02

In the Constant RF (CRF) mode the TRM never actually reads a key. Instead the exciter coil is constantly energized at 134.2 KHz. This is accomplished by physically grounding pin 13 of the TIRIS transceiver chip. No messages are sent, nor received on J1939. This mode is primarily used for EMC emissions testing since it is considered to be the "worst-case" emissons state.

Note: All tests should be performed for both 24v NSV and 12v NSV unless it can be clearly shown that the severity of the test performed at one voltage level adequately covers the other and therefore the test need not be performed at the second voltage level. This is true not only on the "high" side, but also on the "low" side.

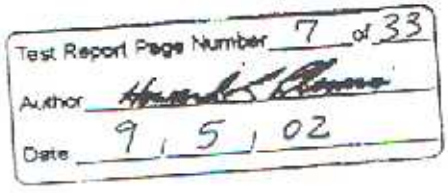
Summarizing:

Steady State
- Coil is off
- TRM is "listening" for request to read on J1939
- TRM is not transmitting any data over J1939

Constant RF (CRF)
- Coil has 134.2 KHz applied continuously
- J1939 requests for key read are ignored by TRM
- No J1939 messages are generated

Constant Key Read (CKR)
- Coil is excited at 134.2 KHz for 50 ms every 0.5 seconds automatically
- Key is read for 20 ms every 0.5 second automatically
- Key read sequence may occur up to 3 times to look for LF R/O TIRIS
- J1939 requests for key read are ignored by TRM
- TRM generates encrypted J1939 after each key read attempt

Emissions testing will be conducted in Steady State and Constant RF modes.
Susceptibility testing will be conducted only in Constant Key Read modes.
Different pass/fail criteria will be used as described below:



1.1.1.3 Pass/Fail Criteria

1.1.1.1.1 Steady State (emissions and transient)

In the Steady State mode there is no way to tell if the TRM is being affected by Radiated EMC, therefore it does not make sense to test for susceptibility.

Although radiated emissions are expected to be very, very low in the steady state mode, we nonetheless are required to test in this mode for FCC and CE certification. A failure is noted if:

1) EC-1 levels are exceeded
2) FCC part 15 class A levels are exceeded
3) ETSI EN300330 levels are exceeded

Voltage transient testing is only performed in the steady state mode because it is believed that since the key read occurs prior to starting the engine, it is not possible for high voltage (except for 80 volt jump-start) to be present while attempts are being made to read the keys. Therefore transient testing is to be conducted on the TRM in the steady-state mode while powered-up, and a failure is noted if the TRM fails to function properly after being exposed to these transients.

1.1.1.1.2 Constant RF (emissions)

This mode is a test mode specifically designed for radiated emissions testing. This mode will not be used during transient testing, nor during susceptibility testing.

Power the TRM with 27.0 volts. This will provide the maximum current going through the coil and therefore will provide the highest levels of emissions. No testing will be performed at 9, 12, 15, 18, or 24 volts because this is a lengthy test.

Emissions testing is to be performed in accordance with:

1) EC-1
2) FCC part 15 (class A)
3) ETSI EN300330

A failure is noted if any of the applicable limits of the above are exceeded.

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Author [signature]
Date 9/5/02

1.1.1.1.3 Constant Key Read (susceptibility and 80 volt jump start)

This is a special test mode constructed specifically for susceptibility testing such that the 500 ms read frequency ensures that with a 2 second dwell at each EMI frequency that at least 3 reads will be observed at each frequency.

Connect a laptop computer with Canalyzer, or a similar means to monitor the message being transmitted from the TRM during this test. Be sure to properly terminate the J1939 cables using two 120 ohm resistors inside the test cell and electrically before the EMC filters in the cell.

The message being transmitted by the TRM should be monitored using the Canalyzer throughout the entire sweep. **Experience has shown us that the two 120 ohm terminating resistors must be mounted inside the chamber because if they are in the control room they will be electrically separated from the TRM by the filters used by the EMC facility, thereby causing communications problems**. Any frequencies or frequency ranges at which the TRM fails to send a key ID, or sends an incorrect key ID should be noted, along with the number of bad reads at that frequency, the frequency range at which these occurred, and the EMC level (v/m) at which this occurs. We acknowledge that there are some lower frequency ranges where this system may only pass 60 v/m and there will be a region in the vicinity of its operating frequency (134 KHz) where it definitely won't pass any level of radiation since its intended purpose is as an antenna. Therefore logging invalid key reads will not necessarily be considered to be a failure of the test. Determination of whether this is a failure will depend on the number of invalid reads, the level, the frequency, and the width of the frequency range in which failures occur. **NOTE: Communications errors, seen as "Error Frame" on the Canalyzer screen, are not considered to be failures, although it is acknowledged that if the communications fails for 2 uninterrupted seconds then it will be impossible to verify that the correct ID was read at that frequency (since we only dwell at each frequency for 2 seconds), so if this should happen we'll need to stop the test and try to improve the communications.**

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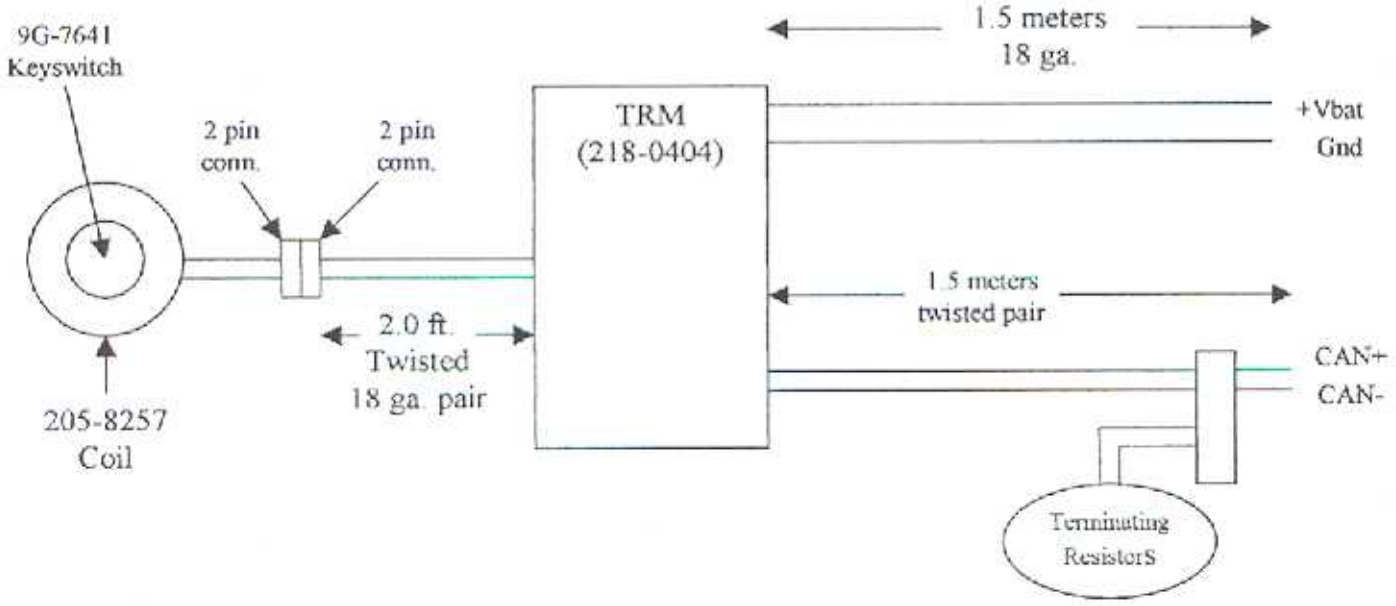
Author [signature]
Date 9/5/02

1.1.2 Part Numbers of DUT

TRM	218-0404 chg 02
Exciter Coil	205-8257
Electronic Key	206-5162
Keyswitch	9G-7641
Software	Special Test Software

1.1.3 Block Diagram of DUT

see attached



1.1.4 Technical Information

1.1.4.1 Oscillator / Clock Frequencies

16.0 MHz system crystal
134.2 kHz nominal RFID frequency
17.1776 MHz RFID crystal

1.1.4.2 Input Circuits

Exciter Coil
Exciter Coil Return

1.1.4.3 Output Circuits

Exciter Coil
Exciter Coil Return

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Author
Date 9/5/02

1.1.4.4 Data Links

CAN (J1939)
RFID communications between the TIRIS transponder and transceiver

1.1.4.5 Power Supply I/O

No external power supplies. Unit may be driven from 12 or 24 NSV battery

1.2 Functional Performance Status Classification of DUT

1.2.1 Functional Status Classification (SAE J1113/1 Jul 95)

1.2.1.1 Selection

Class C – Continuous Key Read (other modes not tested for susceptibility)

NOTE: At frequencies below 20 MHz we will only need to pass 55 v/m. See justification in 1.2.1.2 for further discussion.

1.2.1.2 Justification

In accordance with EU standards for automobile immobilizers ISO13766 Susceptibility is only tested between 20 MHz and 1 GHz (and only to 60 v/m for that range). Although we will test in accordance with EC-1 levels (15 KHz to 1 GHz at 100 v/m) we recognize that we will be susceptible at frequencies near and harmonics of the fundamental RF frequency for which this device attempts to read data from the transponder because in this frequency range we are an intentional receiver. Therefore below 5 MHz we expect that we will only meet about 50 v/m, however to be judged acceptable we will consider the European range (>20 MHz) to be the range where we will need to meet 100 v/m. Below 20 MHz we will only require that this device be capable of reading a key in the presence of a 55 v/m field.

This device is not tested in the Steady State mode because while in that mode it is not performing any operation other than listening for a request to read, and it is not controlling any functions on the machine.

This device is not tested in the Constant RF mode because this is an artificial mode for Emissions testing only.

It should be noted that nearly all of the time that the device is in operation it will be in the Steady State mode except for 70 ms when the keyswitch is turned to the "on" position, therefore this device will be essentially a 100 v/m device for all operation. It will be 100 v/m for all operation above 20 MHz, and it will only be 55 v/m for very few specific frequencies below 20 MHz (and at that this will only be true when 80% 1KHz modulation is used).

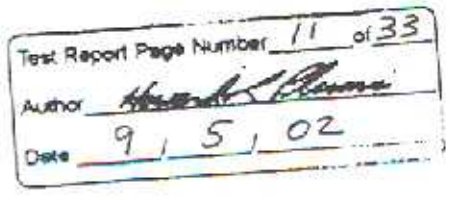
1.2.2 Performance Regions (SAE J1113/1 Jul 95)

1.2.2.1 Selection

Region 1 – The ECM shall operate as designed during and following exposure to disturbance.

1.2.2.2 Justification

see 1.2.1.2



2 Test Initialization

2.1 DUT Initialization

2.1.1 Software Part Numbers

Code flashed into TRM — Special test code which automatically reads the key every 500 ms without a request from the host ECM.

NOTE: The actual production application code (220-7153 chg 00) will not be tested here but will be tested at the subsystem level by Mike Staub.

2.1.2 Hardware Initialization

Unless otherwise specified, all tests will be executed with the following hardwareconfiguration:

1) The power and ground leads will be 1.5 meters in length, 18 ga. wire. For testing performed in the SAC these wires will go through the filter box.
2) The CAN+ and CAN- wires shall be 1.5 meters and will be made of twisted pair 22 ga. wire. For tests in the SAC the two terminating resistors (both 120 ohms) shall be inside the test cell and electrically precede the EMC filters in the cell.
3) The exciter coil shall be connected to the TRM using a 2.0 ft. length of 18 ga. wire. This 2.0 ft. is the measured distance between the 2-pin Deutsch connector for the 205-8257 (exciter coil) and the 8-pin Deutsch connector which connects to the TRM. The coil must be mounted to a 9G-7641 keyswitch.
4) Connect the laptop (inside the control room) with Canalyzer software to the CAN bus. Connect a power supply capable of supply 27 volts and 1 amp to the power and ground leads. Connect an ammeter (Fluke 87 or similar) on the power line to monitor average current draw for some tests.
5) Insert a 206-5162 Cat Electronic Key fully into the 9G-7641 keyswitch. Apply power to the TRM. Verify that the correct ID is being displayed and updated (every 500 ms) on the laptop with the Canalyzer. Remove the key. Verify that the Canalyzer now receives the message (0xdeadbeef) Reinsert the key
6) Connect an oscilloscope using spoons to the exciter coil to verify that the exciter frequency is 134 KHz and that the peak-to-peak voltage at the coil is approximately 25 volts (can be as low as 15 or as high as 40). Remove the scope and begin running the test.

2.1.3 Software Initialization

1) Flash the special Test Software into the DUT using the 6-pin BDM connector on the board assembly.
2) With the electronic key inserted into the keyswitch power up Canalyzer software on laptop inside control room.
3) Verify that the TRM is transmitting correct key ID to Canalyzer.
4) Remove the key from keyswitch and verify that the message received by the Canalyzer changes to "deadbeef".
5) Reinsert the key and verify that the TRM once again transmits the correct key ID.

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Author
Date 9/5/02

2.2 Procedure for Monitoring Data

2.2.1 Emissions Testing

2.2.1.1 Constant Coil Excitation

Since it is not permitted to have an oscilloscope in the test cell during this test, we can only test the peak-to-peak voltage supplied at the coil before and after each test run. Use an oscilloscope to measure this voltage at the connector with "spoons".

2.2.2 Susceptibility Testing

2.2.2.1 Constant Key Read

Continuously monitor the message transmitted by the TRM using the laptop and Canalyzer. A failure is noted if 3 consecutive "0xdeadbeef" messages appear at any point in the test. A single "0xdeadbeef" does not constitute a failure because in application the TRM software will automatically attempt a second, and even a third key read if the first attempted key read does not return a valid, LF, TIRIS R/O key ID.

2.2.3 Fast Transient Testing

2.2.3.1 Steady State

Monitor the current being supplied to the TRM. At no point should the supplied current exceed 50 mA (DC).

2.2.3.2 Constant Key Read (80 volt jump start only)

Monitor the transmitted CAN message using the Canalyzer software. There must not be any set of 3 consecutive "0xdeadbeef" messages.

2.3 Procedure for Beginning Test

To begin a test, arrange test setup as shown in 1.1.3 and initialize as described in sections 2.1.2 and 2.1.3. Insert Electronic Key into keyswitch and apply power to the TRM.

2.4 Monitoring of Inputs and Diagnostics

Monitoring depends on the test being run. For emissions we only monitor pk-pk voltage to coil before and after test. For susceptibility and 80 volt jump start we monitor the CAN messages. For most tests we also monitor the current being supplied to the TRM.

2.5 Monitoring of Outputs

The only "output" is coil excitation. For emissions testing (constant RF) we only test the peak-to-peak voltage before and after the test is run. No monitoring takes place during test execution.

2.6 Monitoring of Datalinks

CAN operation will be verified using a laptop with Canalyzer. As noted earlier we will not consider a failed transmission (Error Frame) to be a failure unless a solid stream of error frames blocks us from being able to verify system functionality when exposed to a given frequency during susceptibility testing.

2.7 Pass / Fail Criteria

Please refer to section 1.1.1.3.

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Author [signature]
Date 9/5/02

3 EMC Tests

3.1 Radiated Immunity (ISO/DIS 13766)

3.1.1 15 KHz – 150 MHz, SAC / Strip Line

3.1.1.1 Operational Modes to be tested

> Constant Key Read at both 12 and 24 volt NSV

3.1.1.2 Post Test Evaluation of DUT

Verify that the DUT functions properly

3.1.2 100 MHz – 1 GHz SAC

3.1.2.1 Operational Modes to be tested

> Constant Key Read at both 12 and 24 volt NSV

3.2.1.2 Post Test Evaluation of DUT

Verify that the DUT functions properly

3.2 Electrical Fast Transients (ISO 7637-1)

3.2.1 Test Pulse 1 (Inductive Kickback)

3.2.1.1 Operational Modes to be tested

Steady State operation only (inductive kickback cannot occur until after machine is started). DUT should function properly after each pulse. Both 12 and 24 NSV.

3.2.1.2 Post Test Evaluation of DUT

Verify that the DUT functions properly

3.2.2 Test Pulse 2a (Interruption of Series Current)

3.2.2.1 Operational modes to be tested

Steady State operation only (inductive kickback cannot occur until after machine is started). DUT should function properly after each pulse Both 12 and 24 NSV.

3.2.2.2 Post Test Evaluation of DUT

Verify that the DUT functions properly

3.2.3 Test Pulse 2b (Ignition off transients)

3.2.3.1 Operational modes to be tested

Steady State operation only (inductive kickback cannot occur until after machine is started). DUT should function properly after each pulse. Both 12 and 24 NSV.

3.2.3.2 Post Test Evaluation of DUT

Verify that the DUT functions properly

3.2.4 Test Pulse 3a (Negative Spikes)

3.2.4.1 Operational Modes to be tested

Steady State operation only (inductive kickback cannot occur until after machine is started). DUT should function properly after each pulse. Both 12 and 24 NSV.

3.2.4.2 Post Test Evaluation of DUT

Verify that the DUT functions properly

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Author [signature]
Date 9/5/02

3.2.5 Test Pulse 3b (Positive Spikes)

3.2.5.1 Operational Modes to be tested

Steady State operation only (inductive kickback cannot occur until after machine is started). DUT should function properly after each pulse. Both 12 and 24 NSV.

3.2.5.2 Post Test Evaluation of DUT

Verify that the DUT functions properly

3.2.6 Test Pulse 4 (Cranking)

3.2.6.1 Operational Modes to be tested

Steady State operation only (inductive kickback cannot occur until after machine is started). DUT should function properly after each pulse. Both 12 and 24 NSV.

3.2.6.2 Post Test Evaluation of DUT

Verify that the DUT functions properly

3.2.7 Test Pulse 5 (Voltage Mode Load Dump)

3.2.7.1 Operational Modes to be tested

Steady State operation only (inductive kickback cannot occur until after machine is started). DUT should function properly after each pulse. Both 12 and 24 NSV.

3.2.7.2 Post Test Evaluation of DUT

Verify that the DUT functions properly

3.3 Electrostatic Discharge (ISO TR 10605/E)

3.3.1 Handling and Packaging Test

3.3.1.1 Post Test Evaluation of DUT

Apply the ESD pulse to all pins and verify functionality after each set. Upon completion of the test verify the functionality of the entire DUT.

3.3.2 Operational Test

This test is not required. The DUT will not be accessible to the operator during machine operation.

3.4 Emissions (ISO/DIS 13766)

3.4.1 Near Field Radiated Emissions, 150 KHz – 108 MHz

3.4.1.1 Operational Modes to be tested

Constant RF at 24 NSV ONLY.

3.4.2 Near Field Radiated Emissions, 30 MHz – 1 GHz

3.4.2.1 Operational Modes to be tested

Constant RF at 24 NSV ONLY.

3.4.3 Far Field Radiated Emissions, 30 MHz – 1 GHz

3.4.3.1 Operational Modes to be tested

Constant RF at 24 NSV ONLY.

3.5 EMC and Radio Spectrum (EN 300 330)

This testing will be performed at an outside house authorized by the Notified Body

3.6 FCC part 15

Perform this testing in accordance with FCC part 15 for emissions in both Steady State and Constant RF modes. It is only necessary to perform this for 24 NSV since emissions will be worst for this condition. Pass/Fail criteria is to meet standards for Type A control.

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Author [signature]
Date 9/5/02

Electromagnetic Compatibility Test Results

FCC Part 15 B & C
Test Results

DUT Description: Transponder Reader Module

Part Number: 218-0404-01

Individual Test Results:

Test:	Pass	Fail	Not Req.
Radiated Emissions Testing			
Unintentional Radiator - Part 15.109 Subpart B			
Class A – Commercial, Industrial	X		
Class B - Residential			X
Intentional Radiator - Part 15.209, Subpart C			
9KHz – 30MHz	X		
30MHz – >960MHz			X
Conducted Emissions Testing			
Intentional Radiator – Part 15.207			

EMC Engineer: Howard L Plumier

Date: 9-5-02

Radiated

Emissions

Test Results

FCC Part 15C, Class A
Intentional Radiator
Section 15.209
9KHz - 30MHz

Radiated Emissions
- Low Frequency

Sheet: _____ of _____

EC-1,05 9.1.1.2___ EC-1,05 9.2.5.1___ Intentional Radiator

EC-1,06 11.1.6.3___ EC-1,06 11.2.6.3___ Other FCC Part 15 B 9 KHz - 30 MHz

Temperature (°C): 21 Humidity (%): 57 Atmospheric Pressure (in. Hg): 29.08

DUT Classification _____ Limit Level _____

EUT Part #: 218-0404-01 File #: 674 Date: 8/13/02

EUT Description: Transponder Reader Module continuous RF 3.4 Volt P-P out 2.7 volt

__ Narrowband and Broadband __ Broadband Only

Peak Detector Method:

__ Peaks found above the Narrowband Limit.

X No Peaks found above the Narrowband Limit.

Average Detector Method:

__ Points found with Peak - Average ≥ 6 dB (Broadband).

__ Points found with Peak - Average < 6 dB (Narrowband)

Narrowband Pass/Fail:

__ Fail (Narrowband found above Narrowband Limit.)

__ Pass (No Narrowband found above Narrowband Limit.)

Broadband Pass/Fail:

__ Fail (Broadband found above Broadband Limit.)

__ Pass (No Broadband found above Broadband Limit.)

Test Results: X Pass ___ Pass w/dev. __Fail

Testing Purpose: X **Component Certification** __ **System Certification** __ **Engineering Studies**

Testing Customer: X **Internal** __ **External**

Test Conducted By _____ Date: 8/13/02

EMC Engineer Howard L Plumier Date: 9/5/02

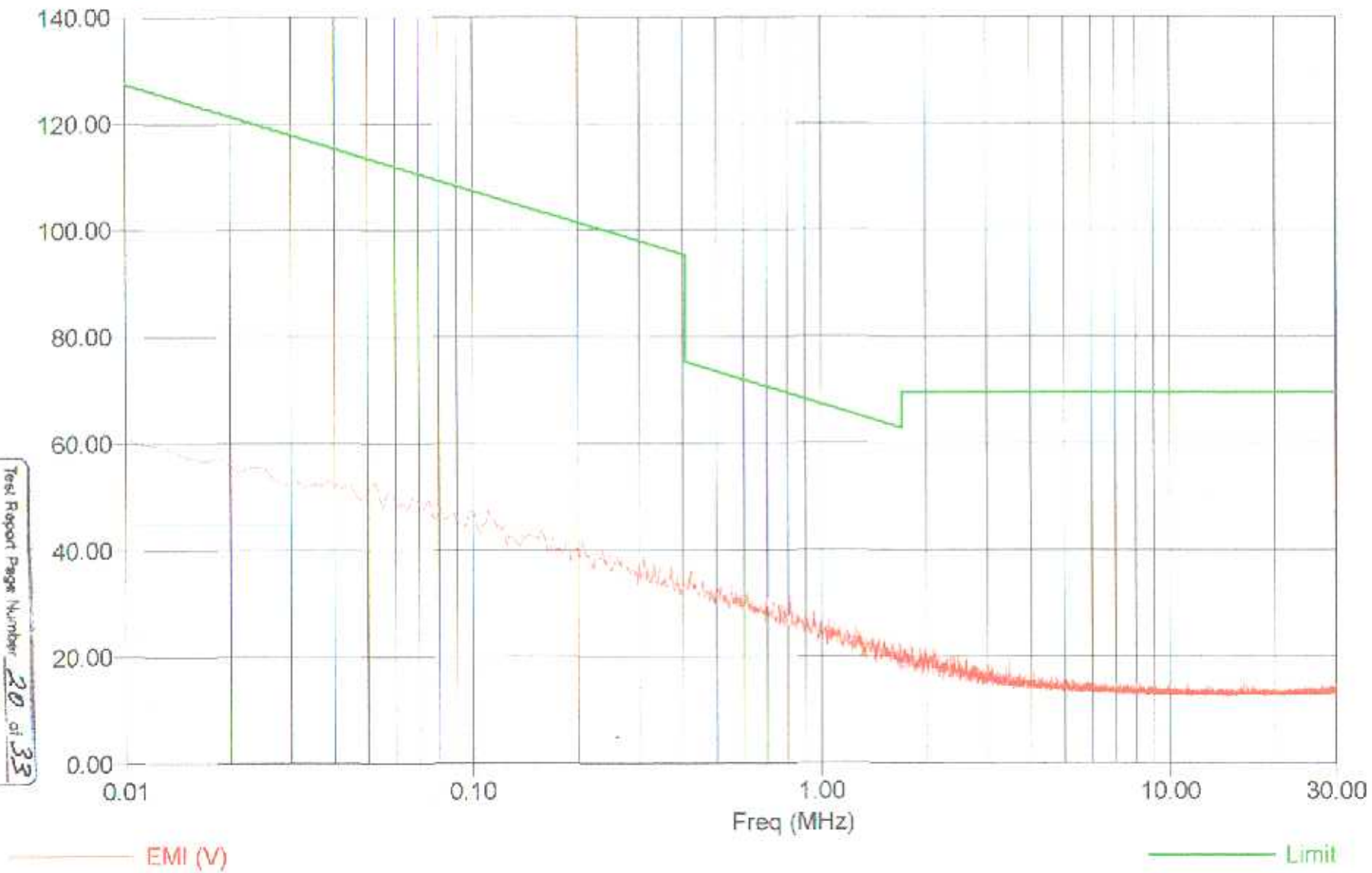
Monitored By _____ Date: 8/13/02

Author: Howard Plumier Date: 9/5/02

Title: Radiated Emissions 10kHz – 30 MHz
File: FCC_PRE.SET
Operator: ADH
EUT Type: Transponder Reader Module P/N 218-0404-01
EUT Condition: File #674
Comments: W/antenna parallel to table; Baseline

08/13/02 12:46:15
Sequence: Preliminary Scan

FCC Part 15C Intentional Radiator



Test Report Page Number 20 of 33
Author
Date 9/5/02

Title: Radiated Emissions 10kHz – 30 MHz

08/13/02 13:37:30

File: FCC_PAR.SET

Sequence: Preliminary Scan

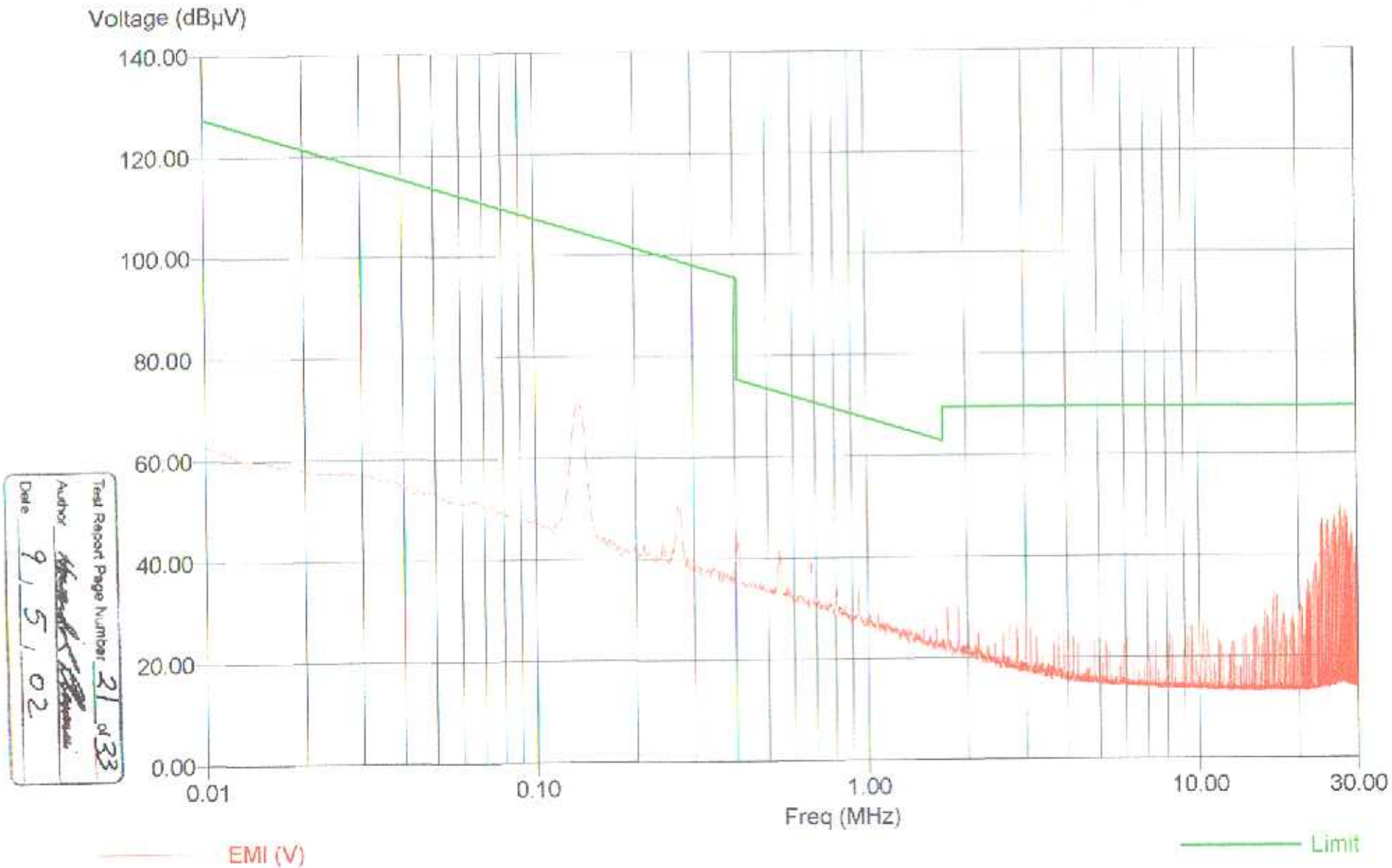
Operator: ADH

EUT Type: Transponder Reader Module P/N 218-0404-01

EUT Condition: File #674

Comments: W/antenna parallel to table; 27 volt, 34 volt P/P, Continuous RF

FCC Part 15C Intentional Radiator



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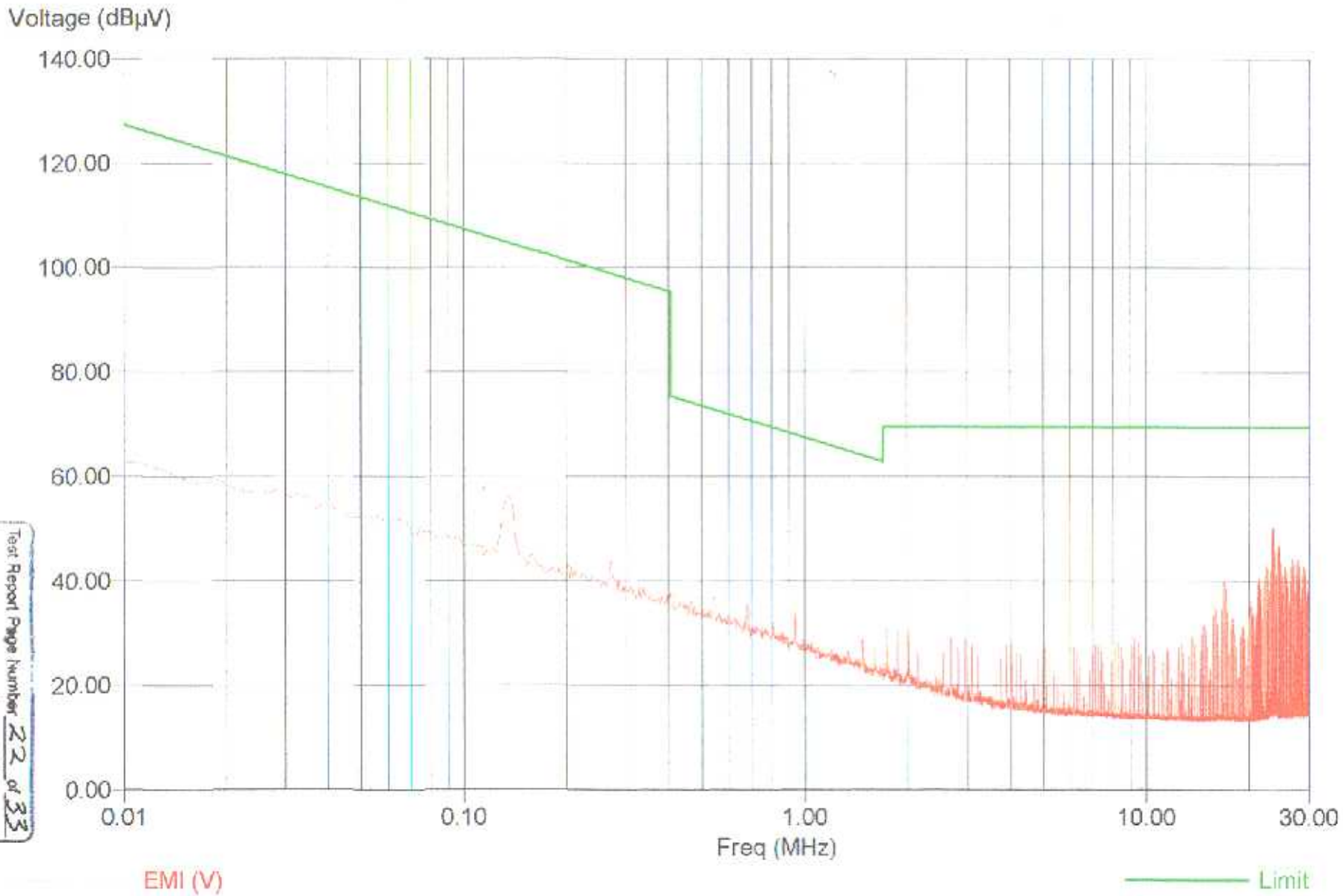
Author

Date 9/5/02

Title: Radiated Emissions 10kIIz – 30 MIIz
File: FCC_PER.SET
Operator: ADH
EUT Type: Transponder Reader Module P/N 218-0404-01
EUT Condition: File #674
Comments: W/antenna perpendicular to table; 27 volt, 34 volt P/P, Continuous RF

08/13/02 14:15:32
Sequence: Preliminary Scan

FCC Part 15C Intentional Radiator



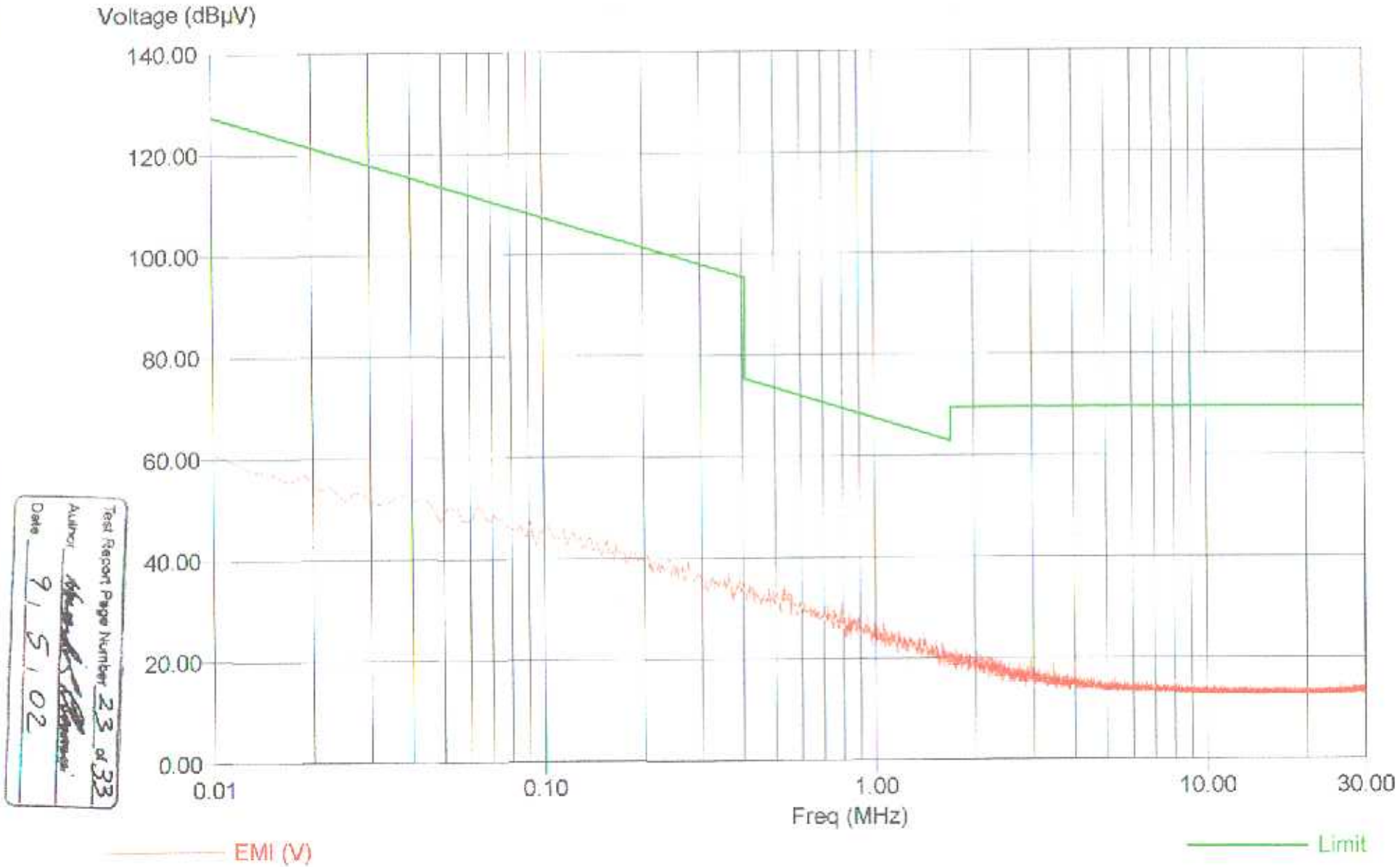
Test Report Page Number 22 of 33
Author
Date 9/5/02

Radiated Emissions 10kHz – 30 MHz

Title:
File: FCC_PER.SET
Operator: ADH
EUT Type: Transponder Reader Module P/N 218-0404-01
EUT Condition: File #674
Comments: W/antenna perpendicular to table; Baseline

08/13/02 14:48:56
Sequence: Preliminary Scan

FCC Part 15C Intentional Radiator



Test Report Page Number 23 of 33
Author
Date 9/5/02

Radiated Emissions @ 3 Meters
9kHz - 30MHz
FCC Intentional Radiator

Emissions Calibration Report

Technician: [illegible] Test Date: 8/13/02
Test Spec.: FCC Part 15B 9KHz-30MHz File #: 674

Equipment Used:

Check if Used:	Description:	IRIS #	Last Calibration	Next Calibration
	Antenna – Bilog (S/N 2087)	54386		
	(S/N 2076)	54388		
	Antenna - Biconnical	13115	For Reference Only	For Reference Only
		54130	For Reference Only	For Reference Only
	Antenna - Active Rod	64665		
X	Antenna – Magnetic Loop	81412	4/22/02	4/22/03
X	EMI Receiver	53327	7/16/02	7/16/03
X	EMI Receiver Filter Section	53326	7/16/02	7/16/03
	Spectrum Analyzer	68945		
	LISN	29101	Calibration	Not Req.
X	Solar LISN	64226	Calibration	Not Req.
X	Solar LISN	75950	Calibration	Not Req.

Radiated

Emissions

Test Results

FCC Part 15B
Class A – Commercial, Industrial
Unintentional Radiator
Section 15.109
30MHz - >960MHz

Radiated Emissions

Sheet: _____ of _____

- High Frequency Near Field

EC-1,05 9.1.4.2___ EC-1,05 9.2.5.2 ___

EC-1,06 11.1.6.4___ EC-1,06 11.2.6.4___ Other FCC Part 15 B Unintentional Radiator 30 MHz. - 1GHz

Temperature (°C): 21 Humidity (%): 57 Atmospheric Pressure (In. Hg): 29.08

DUT Classification _____ Limit Level: ISO 13766

EUT Part #: 218-0404-01 File #: 674 Date: 8/13/02

EUT Description: Transponder Reader Module Continuous RF 24 volt p-p ant. 27 volt

X Narrowband and Broadband ___ Broadband Only

Horizontal Antenna Polarity:

Peak Detector Method:

___ Peaks found above the Narrowband Limit.

X No Peaks found above the Narrowband Limit.

Average Detector Method:

___ Points found with Peak - Average ≥ 6 dB (Broadband).

___ Points found with Peak - Average < 6 dB (Narrowband).

Narrowband Pass/Fail:

___ Fail (Narrowband found within 2dB of NB Limit.)

X Pass (No Narrowband found within 2dB of NB Limit.)

Quasi-Peak Detector Method:

___ Fail (Broadband Quasi Peak Levels within 2dB of Broadband Quasi Peak Limit)

X Pass (Broadband Quasi Peak Levels at least 2dB less than Broadband Quasi Peak Limit)

Vertical Antenna Polarity:

Peak Detector Method:

___ Peaks found above the Narrowband Limit.

X No Peaks found above the Narrowband Limit.

Average Detector Method:

___ Points found with Peak - Average ≥ 6 dB (Broadband).

___ Points found with Peak - Average < 6 dB (Narrowband).

Narrowband Pass/Fail:

___ Fail (Narrowband found within 2dB of NB Limit for ISO 13766)

X Pass (No Narrowband found within 2dB of NB Limit for ISO 13766.)

Quasi-Peak Detector Method:

___ Fail (Broadband Quasi Peak Levels within 2dB of Broadband Quasi Peak Limit)

X Pass (Broadband Quasi Peak Levels at least 2dB less than Broadband Quasi Peak Limit)

Test Results: X Pass ___ Pass w/dev. ___ Fail

Testing Purpose: X Component Certification ___ System Certification ___ Engineering Studies

Testing Customer: X Internal ___ External

Test Conducted By _____ Date: 8/13/02

EMC Engineer Howard L Plumier Date: 9/5/02

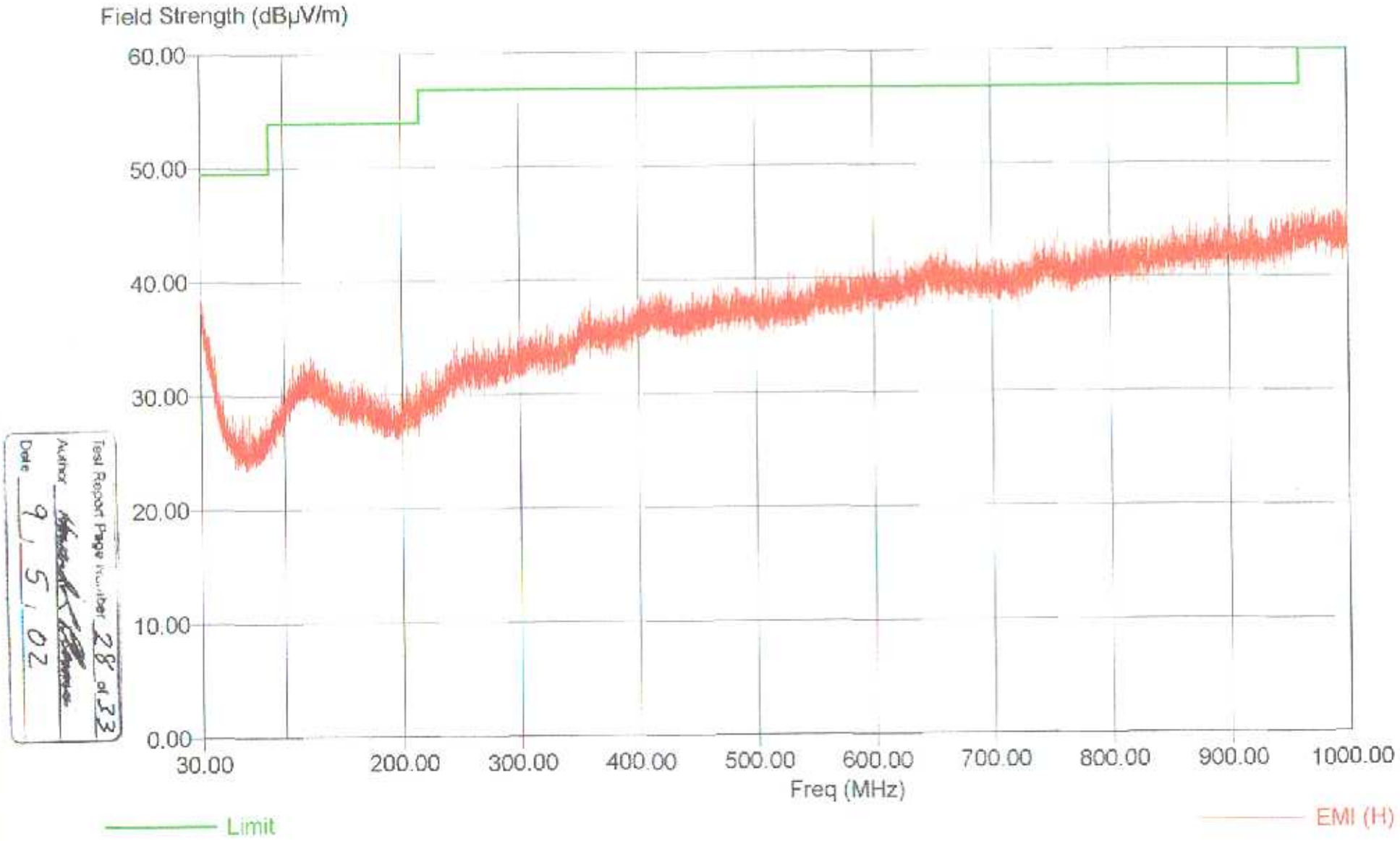
Monitored By David B Duff Date: 8/13/02

Author: Howard Plumier Test Report Page # 27 of 33 Date: 9/5/02

Title: Radiated Emissions 30MHz to 1GHz
File: FCC_HBAS.SET
Operator: ADH
EUT Type: Transponder Reader Module P/N 218-0404-01
EUT Condition: File #674 - Baseline
Comments: Horizontal Polarization - FCC 3 meter test from 30MHz to 1GHz, using Class A limit li
nes, extrapolated from 10 to 3 meters.

08/13/02 09:11:37
Sequence: Preliminary Scan

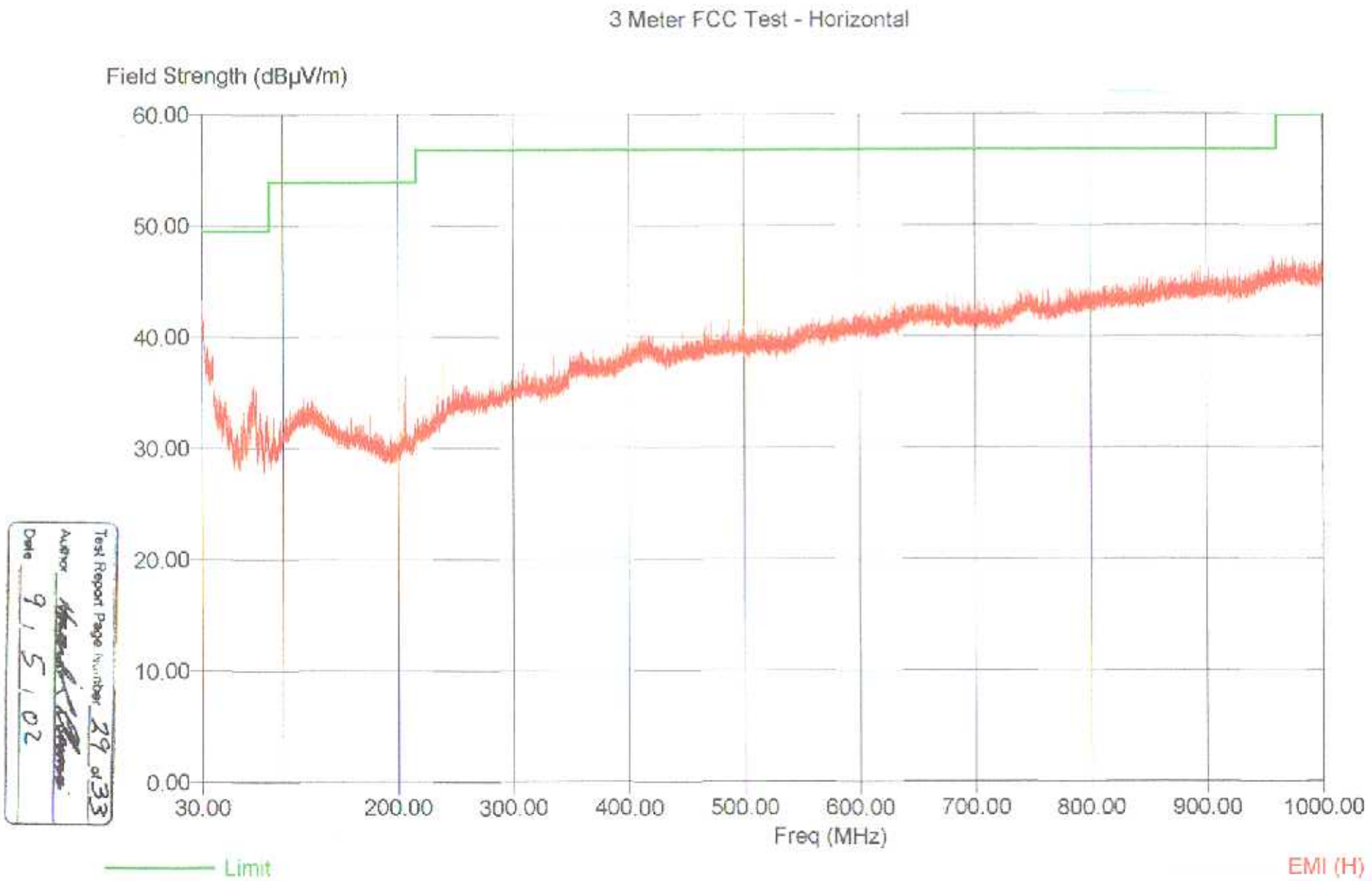
3 Meter FCC Test - Horizontal



Test Report Page Number 28 of 33
Author
Date 9/5/02

Title: Radiated Emissions 30MHz to 1GHz
File: FCC_HBAS.SET
Operator: ADH
EUT Type: Transponder Reader Module P/N 218-0404-01
EUT Condition: File #674 - Continuous RF, 27 volt, 34 volt P/P
Comments: Horizontal Polarization - FCC 3 meter test from 30MHz to 1GHz, using Class A limit lines, extrapolated from 10 to 3 meters.

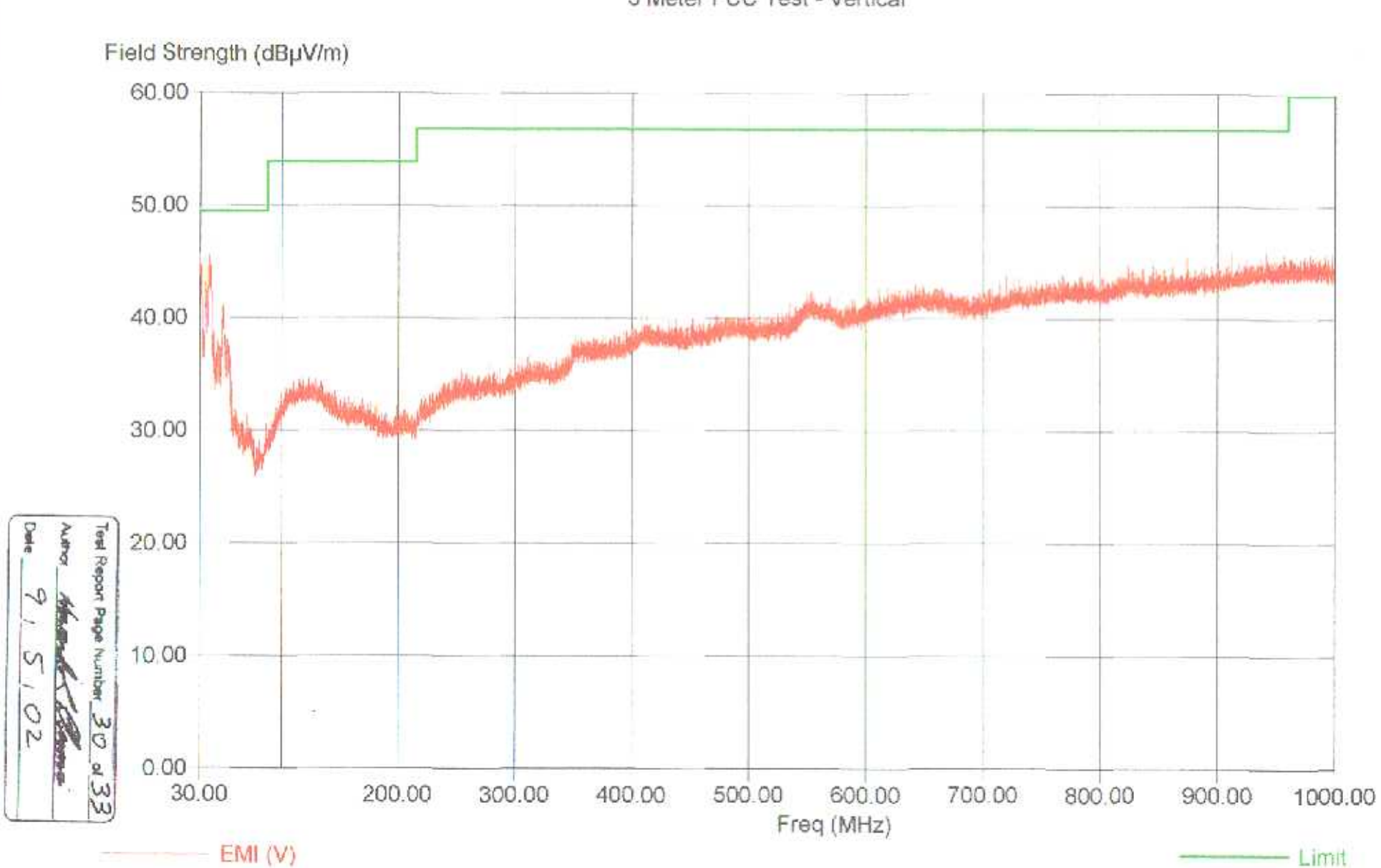
08/13/02 09:21:22
Sequence: Preliminary Scan



Test Report Page Number 29 of 33
Author
Date 9/5/02

Title: Radiated Emissions 30MHz to 1GHz
File: FCC_VBAS.SET
Operator: ADH
EUT Type: Transponder Reader Module - P/N 218-0404-01
EUT Condition: File #674
Comments: Vertical Polarization - FCC 3 meter test from 30MHz to 1GHz, using Class A limit lines, extrapolated from 10 to 3 meters. 34 volt P/P, 27 volt.

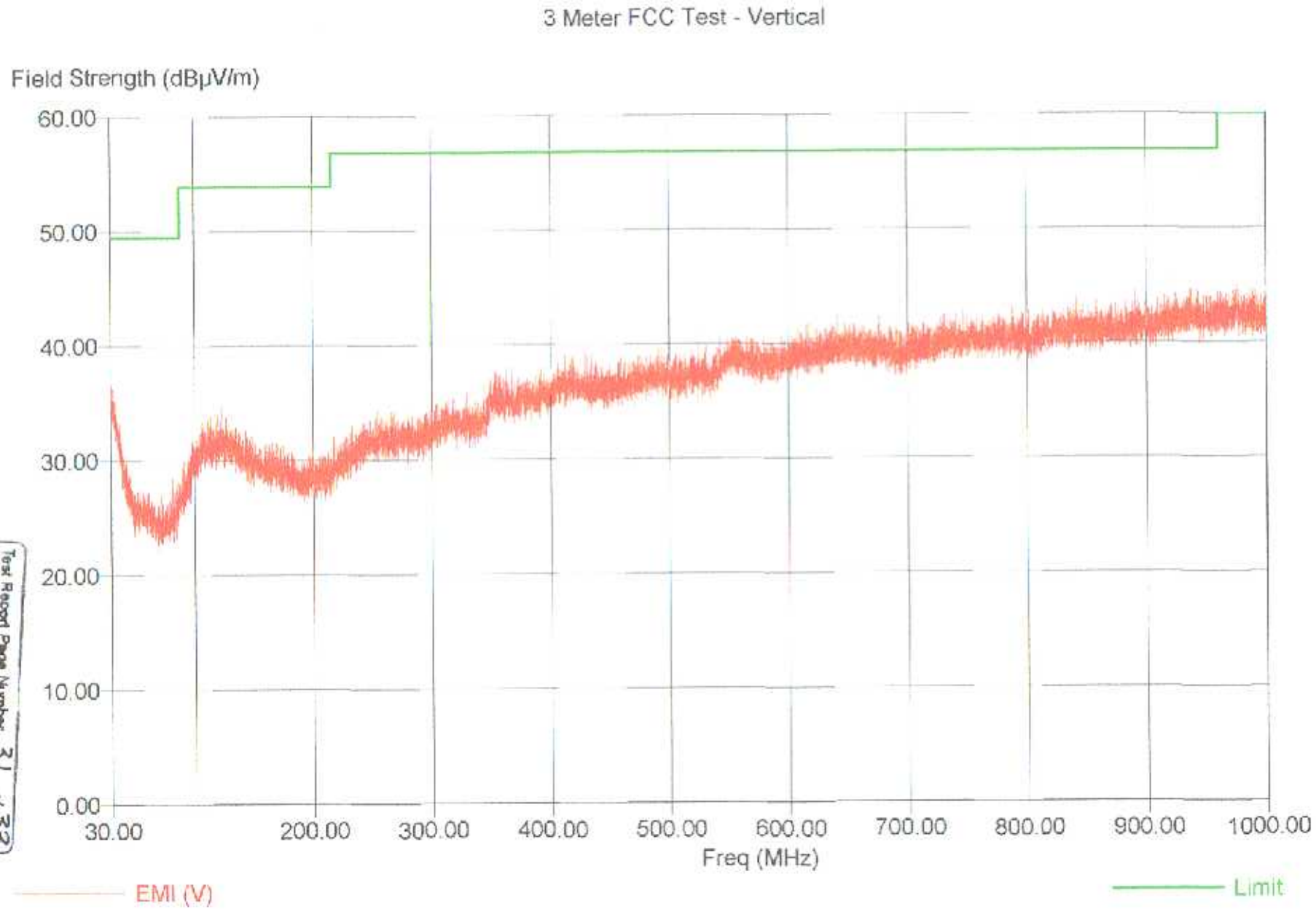
08/13/02 10:45:54
Sequence: Preliminary Scan



Test Report Page Number 30 of 33
Author
Date 9/5/02

Title: Radiated Emissions 30MHz to 1GHz
File: FCC_VBAS.SET
Operator: ADH
EUT Type: Transponder Reader Module - P/N 218-0404-01
EUT Condition: File #674 - Baseline
Comments: Vertical Polarization - FCC 3 meter test from 30MHz to 1GHz, using Class A limit lines, extrapolated from 10 to 3 meters.

08/13/02 11:48:40
Sequence: Preliminary Scan



Test Report Page Number 31 of 33
Author
Date 9/5/02

Radiated Emissions @ 3 Meters
30MHz - 1 GHz
FCC Unintentional Radiator

Test Report Page Number 32 of 33
Author
Date 9, 5, 02

Emissions Calibration Report

Technician: [illegible] Test Date: 8/13/02
Test Spec.: FCC Part 15-B 30MHz-1GHz File #: 674

Equipment Used:

Check if Used:	Description:	IRIS #	Last Calibration	Next Calibration
	Antenna – Bilog (S/N 2087)	54386		
X	(S/N 2076)	54388	6/18/02	6/18/03
	Antenna - Biconnical	13115	For Reference Only	For Reference Only
		54130	For Reference Only	For Reference Only
	Antenna - Active Rod	64665		
	Antenna – Magnetic Loop	81412		
X	EMI Receiver	53327	7/16/02	7/16/03
X	EMI Receiver Filter Section	53326	7/16/02	7/16/03
	Spectrum Analyzer	68945		
	LISN	29101	Calibration	Not Req.
X	Solar LISN	64226	Calibration	Not Req.
X	Solar LISN	75950	Calibration	Not Req.