## 1 MEASUREMENT SCOPE

The Model LR200 was certified by FCC for use with the metal tank, concrete tank and plastic tank. For the worst case of measurements for compliance with FCC 15.209, the SITRANS LR200 was tested when it was placed on a plastic tank

## 2 CLASS II PERMISSIVE CHANGE / MODIFICATIONS

Summary of the changes to the Radar Technology Board for LR200

| Sheet | Old | New |
| --- | --- | --- |
| 1 | Bandpass filter based on LC resonator and single transistor followed by a low gain amplifier. The filter is tunable by selecting capacitors in a C-2C network. A shift register is programmed by the microcontroller | Bandpass filter using operational amplifier based active filter design that is tuned by adjusting a digital potentiometer. Transistor is now just a simple gain stage with higher input impedance |
| 2 | Ramp generator needs inverted signal generated from page 4 | Inverter for RAMP signal is shown on this page |
| 3 | RAMP_Threshold logic signal is redundant and needs several XOR gates. Long lines are terminated to reduce ringing at logic gate inputs (R33/34 C104/105) | Redundant signal is removed, logic is minimized (AND gate). One gate used for extra drive (U10) is removed. Logic gates for pulser drive are moved off this sheet to shorten lines to pulser and to place then under the RF EMI shield. Line termination impedance are removed because lines are shortened (R33/34 C104/105) |
| 4 | Basic pulse circuit with ~200 ohm line impedance | Drive gates for transistor pulsers are moved closer to transistor and must be powered from 3.3V. Add a regulator here because it needs to be intrinsically safe. Reduce capacitors to save power. |

| Sheet | Old | New |
|---|---|---|
| 5 | A calibration signal at 22KHz generated by the microprocessor is attenuated to a selectable level of 60dB or 20dB re 1uV RMS. Solid state relay based on MOSFETS isolates the low impedance calibration signal when the frequency of 500KHZ is used for normal operation | Use only one signal level, get rid of unnecessary MOSFETs. Single MOSFET increase impedance when calibration is complete.<br><br>The calibration circuitry was moved to page 7. |
| 6 | RF section<br>Loose ends and connector naming | No changes to schematic or operation of RF components on new page 6. Inverter for logic signal is shown here now. |
| Layout | | Receiver has been moved from underneath the PCB to new location inside the EMC shield.<br>Logic gates for pulser drive have moved to under the RF shield along with their voltage requlator |

## 3 EQUIPMENT UNDER TEST

LR200 – new temperature compensated release

# 4 MEASUREMENT METHOD

All tests were done using the measurements standards (instrumentation and the methods) recommended in part 15.31.

## 4.1 Test Equipment List

- Anritsu 2687B spectrum analyzer – 9 kHz-30GHz, SN 6200440593
- HP8449B wideband amplifier – 1GHz-26.5GHz, SN 3008A01069
- DRH0118 wideband antenna – 1-18GHz, SN 980114
- EMCO 3116 wideband antenna, 18-40GHz, SN 00027169

## 4.2 Instrument settings and computation method

The detector functions and bandwidths have been chosen according to part 15.35. The spectrum analyzer has been set as follows

- RBW = VBW = 3MHz
- Peak detection
- Peak hold

Above 1GHz the peak values of the electric field are computed without applying pulse desensitization because peak detection is used (15.35.b).

*Peak Field Strength (dBµV/m) = E @ antenna (dBµV/m) when measured with peak detector*

The true peak field strength is computed applying pulse desensitization

*True Peak Field Strength (dBµV/m) = Peak Field strength (dBuV/m) + Pulse desensitization correction factor(dBm)*

The average value of the field strength is computed considering the pulse desensitization correction factor and the duty cycle correction factor

*Avg. Field strength (dBuV/m)*
*= Peak Field strength (dBuV/m) + Pulse desensitization correction factor(dBm)*
*+ Duty cycle correction factor (dBm)*

In HP Application note 150-2 the pulse desensitization correction factor when the Spectrum analyzer RBW > PRF is defined as

*Pulse Desensitization Correction Factor(dBm) = - 20 log (1.5 RBW * Effective Pulse*

*Width) = -20 log(1.5*3E6*1.1E-9) = +46.1dB*

The duty cycle correction factor is defined as

*Duty cycle correction factor = 20 log (Effective pulse width / PRI) =*
*= 20 log (1.1E-9/2E-6) = -65.2dB*

At 6.3 GHz the constants used for computation are

- Antenna factor 46.2 ( for DRH0118 wideband antenna)
- PA Gain (dB) = 29.6dB (including cable loss)
- Pulse Desensitization Correction Factor = 46.1dB
- Duty cycle correction factor = -65.2dB

## 5 MEASUREMENT CONDITIONS:

Tests with the unit placed on a plastic tank have been run because this is considered to be the worst of the three representative application configurations (metal, concrete and plastic tanks)

The test antenna has been placed at 3m and then at 0.3m from the tank with the EUT in normal operating mode. Both vertical and horizontal polarizations have been scanned.

The measurements have been performed under normal operating conditions.

**MEASUREMENT RESULTS:**

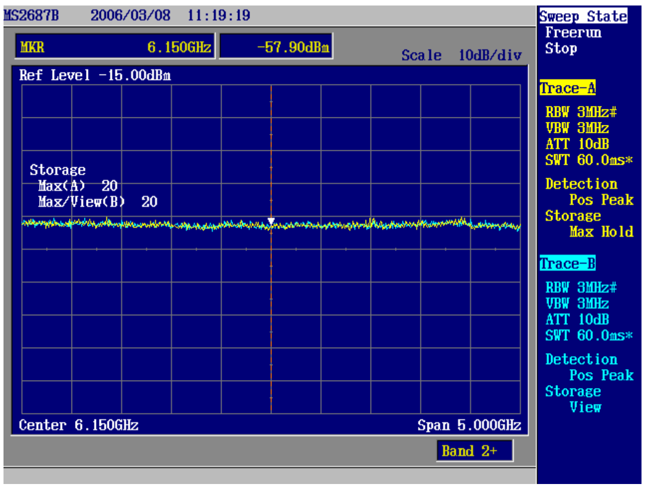
5.1 Transmitting antenna pointed toward the tank, scan at 0.3m

Note: The Model LR 200 was tested with the 8” Horn Antenna with maximum gain of 21 dBi

| FREQUENCY (GHz) | DETECTOR | ANTENNA POLARIZATION | ANALYSER REDING (dBuV) | FIELD STRENGTH (E) @3m (dBuV/m) | LIMIT @ 3m 15.209 (dBuV/m) | MARGIN (dB) | PASS/ FAIL |
|---|---|---|---|---|---|---|---|
| 1-18GHz | Peak/Average | H/V | << | << | 74/54 | << | PASS |
| 18-26.5GHz | Peak/Average | H/V | << | << | 74/54 | << | PASS |

<< - Insignificant or un-measurable

- The frequency was scanned up to 26.5GHz - the upper limit of the PA bandwidth




Scan at 6.15GHz with span 5GHz (yellow - signal, blue – noise floor)


Scan between 1-18GHz (yellow - signal, blue – noise floor)


Scan between 18GHz -26.5GHz ((yellow - signal, blue – noise floor))