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MK5 Calibration Application Note

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Change Log

Version	Date	Comments
1.0	20 Jan 2016	Initial Version
1.1	12 Apr 2016	More information throughout, especially on DC offset and IQ imbalance calibration. Updates for Release 13.2

Table of Contents

1 MK5 Calibration

Calibration of the MK5 involves the following parameters

- Tx IQ Imbalance
- Tx DC Offset
- Tx Power accuracy
- Rx signal strength indicator (RSSI)

The transmit IQ imbalance and DC offset calibration is discussed in Section 2, the Tx Power calibration is discussed in Section 3 and the RSSI calibration is discussed in Section 4.

2 Tx DC Offset and IQ Imbalance calibration

Calibration of the Transmit IQ imbalance and DC offset correction is automated on the MK5. They are both only performed at startup and the calibration cannot be disabled. It has been found that there is no need to rerun the calibration periodically or as temperature varies. However it is possible to rerun the Tx IQ imbalance and DC offset correction calibration algorithm by issuing the command “llc cal”.

Tx DC Offset calibration is performed at two levels; baseband and RF. Baseband DC offset correction is applied at the SAF5x00 and the RF DC offset (LO leakage) correction is applied at the TEF5x00. It is possible to read the baseband DC offset and IQ imbalance settings from Table 1 below. These registers are available via the “llc reg r 0 <reg_num>” command. Note the MK5 command “llc reg r 0” will read the complete bank of TxPHY registers. Given the registers in Table 1are provided as output only, any writes to these registers have no effect.

Table 1 – Baseband Tx IQ Imbalance and DC Offset Register Outputs

Number	Antenna	Register	Range	Description
0	Ant1	IQCross	SQ7	I = I + IQCorr*Q
1	Ant1	Qgain	SQ7	Q = Q + Qgain*Q
2	Ant1	DCOffsetI	SQ11	Baseband DCOffset Inphase
3	Ant1	DCOffsetQ	SQ11	Baseband DCOffset Quadrature
20	Ant2	IQCross	SQ7	I = I + IQCorr*Q
21	Ant2	Qgain	SQ7	Q = Q + Qgain*Q
22	Ant2	DCOffsetI	SQ11	Baseband DCOffset Inphase
23	Ant2	DCOffsetQ	SQ11	Baseband DCOffset Quadrature

Accessing the RF DC offset registers for all 32 transmit gains is only possible by reading the Wispa registers via the “llc reg r 5 <reg_addr>” or via a complete dump of the registers by issuing the “llc raw 25” command. Details of these registers are available via NXP documentation.

2.1 PCBLoad Setting

Due to issues present in early versions of the MK5CB, the PCBLoad bit settings dictate whether the Tx DC offset and IQ imbalance calibration is performed on Antenna 2 or not. Table 2 shows that PCB Load must be set to 4 or higher in order for the Antenna 2 calibration to be performed.

Table 2 – PCBLoad Settings Impact on Tx IQ Imbalance and DC Offset Calibration at Startup

PCB Load Settings	Antenna 1 Calibration	Antenna 2 Calibration
0 to 3	Yes	No
4 to 7	Yes	Yes

Note when issuing the “llc cal” command, both Antenna 1 and Antenna 2 calibrations are performed.

3 Tx Power Calibration

The IEEE802.11p standard dictates that the transmit power be within +/-2dB of the requested power. This means that the transmit power needs to be calibrated across temperature and individual board level variations. The MK5 provides the following options for the Tx Power calibration (set by the Tx power detector calibration messages).

- No calibration
- Temperature only based calibration
- Tx power detection + initial temperature calibration

Figure 1 provides a simple state machine of the transmit power calibration. It shows that the default calibration method is the power detector based scheme, although this scheme relies initially on the temperature based calibration until a valid PowerDet value is performed. It also shows that the config can be changed to temperature only scheme or completely disabled, via the LLC API, as described in Section 3.2.3.

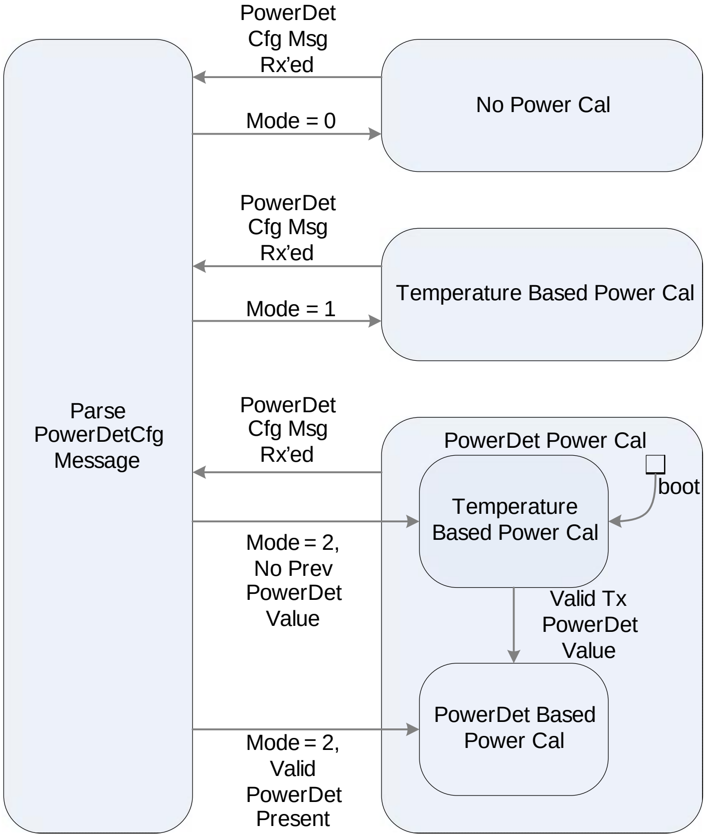

Figure 1 – Tx Power Calibration Configuration State Machine

Due to the potential transmit power amplifier (PA) gain variation, as described in the corresponding PA datasheets, it is expected that the temperature only based transmit calibration cannot be used without per board/module level offset calibration. Hence why the power detector based calibration is the preferred and default method for power calibration. However the temperature based method is still provided by the MK5 firmware as the scheme can achieve the required +/-2dB specification on an individual board basis if the default power offsets match or are tailored for each individual board.

This document provides further details of both temperature only and the tx power detector schemes. Details presented here match release 13.2 of the MK5 firmware/software.

3.1 Tx Power Temperature based calibration

The temperature based tx power calibration relies solely on temperature measurements for calibrating the transmit power. The PA gain has a predominantly a linear relationship with respect to temperature, making the compensation relatively straight forward. The MK5 provides the ability to use the temperature measurements to compensate for the Tx PA gain variation. The temperature source can either be

- manual (supplied by the host),

- a single I2C temperature sensor (applied to both PAs) or
- dual I2C temperature sensors (one for each PA).

The compensation uses the following formula

$$Power\ compensation = PowerCalTempFactor * CurrentTemp + PowerCalTempOffset$$

The PowerCalTempFactor is in dB/°C and the PowerCalTempOffset is effectively the amount to compensate the power by at 0°C. The power compensation (in dB) is added to each requested transmit power, in order to correct for the PA variation. Thus a positive power compensation value will result in more power being added to the drive power. Given the PA gain drops as the temperature increases, it is expected that the PowerCalTempFactor be a positive number. Please note there is an additional power offset applied to the power compensation when using the temperature base calibration. This is described in Section 3.2.5.

3.1.1 Temperature calibration configuration

The LLC API provides the ability to configure the temperature calibration configuration parameters. This includes the sensor source, I2C sensor addresses, the power calibration temperature offsets and temperature factors and also a power limit operation, where the power is limited to a maximum power at a specified temperature. The parameters are listed in the following extract of the MKxTempConfigData data structure.

```
typedef struct MKxTempConfigData
{
  /// Number of I2C temperature sensors connected to the SAF5x00
  tMKxTempSource SensorSource;
  /// I2C Address for the PA Ant1 I2C temperature sensor
  uint8_t I2CAddrPAAnt1;
  /// I2C Address for the PA Ant2 I2C temperature sensor
  uint8_t I2CAddrPAAnt2;
  /// Power calibration factor for temperature compensation (S15Q16 format)
  int32_t PowerCalTempFactorAnt1;
  /// Power calibration offset (dB) for temperature compensation (S15Q16 format)
  int32_t PowerCalTempOffsetAnt1;
  /// Power calibration factor for temperature compensation (S15Q16 format)
  int32_t PowerCalTempFactorAnt2;
  /// Power calibration offset (dB) for temperature compensation (S15Q16 format)
  int32_t PowerCalTempOffsetAnt2;
  /// Maximum temp (degC) for when tx power is limited to PowerLimitMaxPower
  int16_t PowerLimitMaxTemp;
  /// Set maximum power (in 0.5 dBm units) when maximum temperature is reached
  tMKxPower PowerLimitMaxPower;
} __attribute__((__packed__)) tMKxTempConfigData;
```

Note the S15Q16 fixed point format scales the values such that 1.0 = 2^{16} = 65536.
Examples:

- -0.8 in S15Q16 representation is -52429 (0xffff3333) or -0.8 * 2^{16}
- 3.9154 in S15Q16 representation is 256600 (0x0003ea58) or 3.9154 * 2^{16}

The LLC API provides the ability to update/overwrite the above parameters via the fMKx_TempCfg function. Further details are available via the LLCAPI.h header file and the MKxAPI specification document [1].

3.1.2 Temperature calibration commands

An LLC application plugin (llc temp) provides the ability to report the current temperature and report/control the temperature calibration configuration.

```
root@MK5:~# llc temp -h
MKx temperature:
llc temp cfg                          # Get the temperature configuration
llc temp cfg n i1 i2 f1 o1 f2 o2 t p  # Set the temperature configuration
llc temp                              # Get the current antenna temperature readings
llc temp t1 t2                        # Set the antenna temperature values
Where:
  n:  Number of I2C temperature sensors connected to the SAF5x00 (0..2)
  i1: I2C Address for the PA Ant1 I2C temperature sensor (0..255)
  i2: I2C Address for the PA Ant2 I2C temperature sensor (0..255)
  f1: Power calibration factor for temperature compensation (-99.999...99.999)
  o1: Power calibration offset [dB] for temperature compensation (-99.999...99.999)
  f2: Power calibration factor for temperature compensation (-99.999...99.999)
  o2: Power calibration offset [dB] for temperature compensation (-99.999...99.999)
  t:  Maximum temp [degrees C] for when Tx power is limited to 'p' below (-127..127)
  p:  Maximum power (in 0.5 dBm units) when maximum temperature is reached (0...64)
  t1: Measured Temperature [degrees C] for the PA Ant1 I2C temperature sensor (-127..127)
  t2: Measured Temperature [degrees C] for the PA Ant1 I2C temperature sensor (-127..127)
```

To read the current configuration parameters, use the following command (note default configuration values are shown)

```
root@MK5:~# llc temp cfg
SensorSource           2
I2CAddrPAAnt1          112 (0x70)
I2CAddrPAAnt2          113 (0x71)
PowerCalTempFactorAnt1 3073 (0x00000c01 0.047)
PowerCalTempOffsetAnt1 -52429 (0xffff3333 -0.800)
PowerCalTempFactorAnt2 3073 (0x00000c01 0.047)
PowerCalTempOffsetAnt2 -52429 (0xffff3333 -0.800)
PowerLimitMaxTemp      105
PowerLimitMaxPower     20 (10.0 dBm)
```

To overwrite the temperature calibration configuration, use the llc temp cfg with the parameters populated, as shown in the following example. Note that the temperature factor and offset parameters are entered as floats only.

```
root@MK5:~# llc temp cfg 2 72 73 0.05 -1.0 0.048 -0.5 110 30
root@MK5:~# llc temp cfg
SensorSource           2
I2CAddrPAAnt1          72 (0x48)
I2CAddrPAAnt2          73 (0x49)
PowerCalTempFactorAnt1 3277 (0x00000ccd 0.050)
PowerCalTempOffsetAnt1 -65536 (0xffff0000 -1.000)
PowerCalTempFactorAnt2 3146 (0x00000c4a 0.048)
PowerCalTempOffsetAnt2 -32768 (0xffff8000 -0.500)
PowerLimitMaxTemp      110
PowerLimitMaxPower     30 (15.0 dBm)
```

To read the current temperature, as provided by the current SensorSource setting, use the following command.

```
root@MK5:~# llc temp
TempPAAnt1 41
TempPAAnt2 40
```

3.2 Tx Power Detection Calibration

On the MK5, the Skyworks SKY85710 PA provides an integrated power detector. The analogue voltage power detector output is read by the TEF5x00/SAF5x00, thus making it available for closed loop transmit power calibration.

At startup, this scheme uses the temperature based calibration, relying on temperature readings from either the I2C temperature sensors or via temperature messages from the host, as presented in Section 3.1. When a valid power detection measurement is performed, a calibration offset is determined. Each power detection measurement updates the calibration offset. The calibration offset is simply the difference between the drive power and the measured power. If for instance, the drive power for the radio was 20 dBm but the measured power was 19 dBm, then the calibration offset is 1 dB. So the next transmission will be increased by 1 dB. The conversion of the power detector value to the measured power is described in Section 3.2.1.

Power detection measurements are enabled periodically, with the period set by the PowerDetReadPeriod parameter. The default period is 1 second.

A measurement is only performed when the power detector is enabled and a transmission is performed. Note that the calibration offset is only updated if the power detector is greater than or equal to the 1st calibration point, described in Section 3.2.1.

The power detection is only performed on a single antenna during a single frame transmission. Thus if the radio is configured for dual antenna operation and transmission is performed on both antennae for a single frame, the radio will only measure the power on one of the antennas. The radio however toggles between the two antennae (if the last measurement was performed on Ant1, the next one will be performed on Ant2). This effectively doubles the period between calibrations for each antenna.

The power offset compensation uses the following formula

$$Power\ offset\ compensation\ =\ SetPower\ -\ MeasuredPower\ +\ PowerAdjust$$

The SetPower (in dB) is the power setting that was used for the transmission (after all previous calibrations). MeasuredPower is the power detector measured power of this transmission, as further described in Section 3.2.1. PowerAdjust is the temperature compensation of the power measurement and described in Section3.2.2. The Power offset compensation is the amount of power offset that needs to be applied to a requested transmit power to achieve the correct output at the antenna port.

3.2.1 Power detector relationship

When using the power detector for transmit power calibration, the calibration is performed by measurement of the power detector and converting the measurement to an absolute power. The relationship of the power detector value and the absolute power is conveyed using a two line model. Each line is specified by an offset and a rate, i.e.

$$MeasuredPower\ =\ PowerDetectorValue\ *\ PowerRate\ +\ PowerConstant$$

The PowerDetValue is the measured power detector value. With two lines specified, the decision of which line to use is dictated by the PowerDet calibration point values.

- If Measured PowerDetValue < Point1 PowerDet, ignore measurement
- If Point1 PowerDet ≤ Measured PowerDetValue ≤ Point2 PowerDet, use Point1 line
- If Measured PowerDetValue > Point2 PowerDet, use Point2 line

Using the default MK5 values, the above specification results in the following power detector vs measured power relationship. This relationship is used to convert the power detector values to a measured power so it can be compared to SetPower setting.

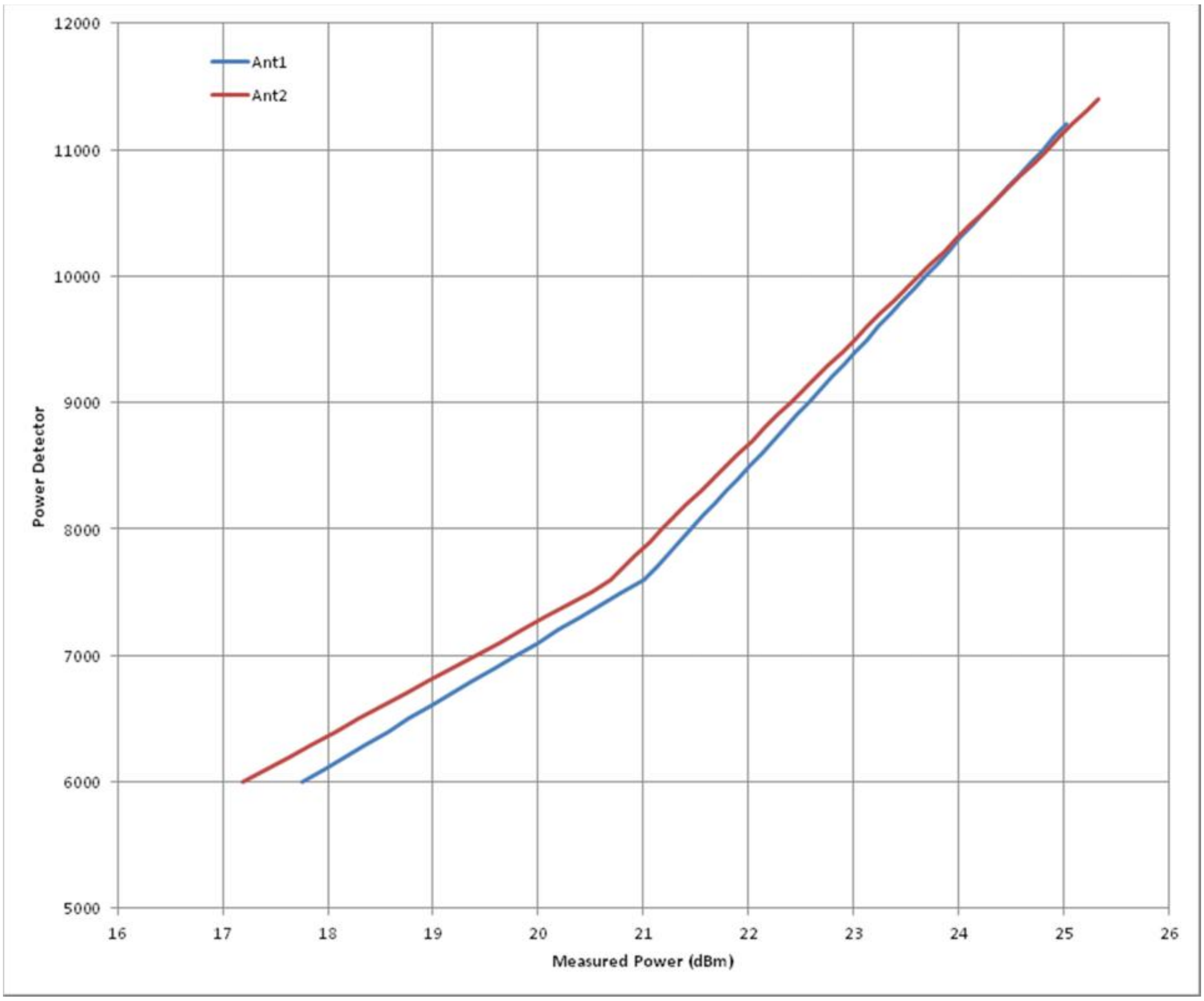

Figure 2 – Default Mk5 Power Detector Calibration (Measured at 40°C)

3.2.2 Power detector temperature relationship

On the MK5, it was found that the power detector behaviour varied across temperature. Thus further calibration is required to scale the power detector vs absolute power relationship due to the current temperature. However this relationship is close to being a linear one, thus the specification is straight forward.
It was found that the power detector varies reasonably linearly by 1.2 dB across the full temperature range of -40 to 85°C (total 125°C).
Given that the default power detector curves have been calculated at a temperature of 40°C, the correction formula is simply:

$$PowerAdjust = (1.2/125) * (CurrentTemp - 40)$$

Note the 1.2/125 factor is upscaled to S15Q16 to obtain adequate resolution, resulting in a default value of 629.

The tMKxPowerDetTempCalPoint data structure which conveys this information, contains both the temperature at which the power detector relationship was determined (CalTemp) and then a rate (TempOffsetRate, in dBm/°C) at which the absolute power needs to be adjusted to with respect to temperature. This results in the following general formula.

$$PowerAdjust = TempOffsetRate * (CurrentTemp - CalTemp)$$

PowerAdjust is the amount of power (in dB) that is added to the power calibration offset.

Example, if the temperature = 80°C, the offset applied to the absolute power is 0.0095978*40 = 0.384 dB.

The CurrentTemp measurement is current temperature, provided by the I2C temperature sensors or provided via the API, as described in Section 3.1.

3.2.3 Power detector configuration

The LLC API provides the ability to alter the power detector calibration via the fMKx_PowerDetCfg function, together with associated data structures. The power detector configuration (tMKxPowerDetConfig) contains

- Top level selection of the calibration mode; none, temperature based calibration or power detector based calibration
- Full specification of the two line power detector calibration for each antenna
- Power detector read period.

Further details are available via the LLCAPI.h header file and the MKxAPI specification document [1].

3.2.4 Power detector commands

An LLC application plugin (llc powerdet) has been provided which allows the power detector parameters to be read and modified via the command line.

```
root@MK5:~# llc powerdet
MKx power detector:
llc powerdet cfg                          # Get the power detector configuration
llc powerdet m cp1a1_p cp1a1_c cp1a1_r cp2a1_p cp2a1_c cp2a1_r cp1a2_p cp1a2_c cp1a2_r cp2a2_p
cp2a2_c cp2a2_r t r p # Set the power detector configuration
Where:
  m:        power calibration mode (off 0, temperature 1 or TxPowerDet 2)
  cp1a1_p: 1st cal point ant1 power detector value
  cp1a1_c: 1st cal point ant1 power in dBm value (S15Q16 format)
  cp1a1_r: 1st cal point ant1 rate dBm/PowerDet from defined point (S15Q16)
  cp2a1_p: 2nd cal point ant1 power detector value
  cp2a1_c: 2nd cal point ant1 power in dBm value (S15Q16 format)
  cp2a1_r: 2nd cal point ant1 rate dBm/PowerDet from defined point (S15Q16)
  cp1a2_p: 1st cal point ant2 power detector value
  cp1a2_c: 1st cal point ant2 power in dBm value (S15Q16 format)
  cp1a2_r: 1st cal point ant2 rate dBm/PowerDet from defined point (S15Q16)
  cp2a2_p: 2nd cal point ant2 power detector value
  cp2a2_c: 2nd cal point ant2 power in dBm value (S15Q16 format)
  cp2a2_r: 2nd cal point ant2 rate dBm/PowerDet from defined point (S15Q16)
  t:        calibration temperature
  r:        rate dBm/deg C from defined point (S15Q16)
  p:        Period between enabling tx power detector reads, in 4MHz ticks
```

Please note, the PowerDetReadPeriod is in 4MHz timer ticks, thus the default value of 4000000 = 1 sec.

Reading of the power detector configuration is as follows (note this output shows the default values)

```
root@MK5:~# llc powerdet cfg
PowerCalMode                2
CalPoint1 Ant1 PowerDet     6000
CalPoint1 Ant1 PowerConstant  365815 (0x594f7 5.5819)
```

```
CalPoint1 Ant1 PowerRate       133 (0x0085 0.0020294)
CalPoint2 Ant1 PowerDet        7500
CalPoint2 Ant1 PowerConstant   822084 (0xc8b44 12.5440)
CalPoint2 Ant1 PowerRate       73 (0x0049 0.0011139)
CalPoint1 Ant2 PowerDet        6000
CalPoint1 Ant2 PowerConstant   256600 (0x3ea58 3.9154)
CalPoint1 Ant2 PowerRate       145 (0x0091 0.0022125)
CalPoint2 Ant2 PowerDet        7500
CalPoint2 Ant2 PowerConstant   747871 (0xb695f 11.4116)
CalPoint2 Ant2 PowerRate       80 (0x0050 0.0012207)
CalTemp                        40
TempOffsetRate                 629 (0x0275 0.0095978)
PowerDetReadPeriod             4000000
```

To overwrite the power detector configuration, use the llc powerdet cfg with the parameters populated, as shown in the following example

```
root@MK5:~# llc powerdet 2 6100 5.6 0.002 6200 5.7 0.0025 6300 5.8 0.003 6400 5.9 0.0035 40
0.009 2000000
root@MK5:~# llc powerdet cfg
PowerCalMode                   2
CalPoint1 Ant1 PowerDet        6100
CalPoint1 Ant1 PowerConstant   367002 (0x5999a 5.6000)
CalPoint1 Ant1 PowerRate       131 (0x0083 0.0019989)
CalPoint2 Ant1 PowerDet        6200
CalPoint2 Ant1 PowerConstant   373555 (0x5b333 5.7000)
CalPoint2 Ant1 PowerRate       164 (0x00a4 0.0025024)
CalPoint1 Ant2 PowerDet        6300
CalPoint1 Ant2 PowerConstant   380109 (0x5cccd 5.8000)
CalPoint1 Ant2 PowerRate       197 (0x00c5 0.0030060)
CalPoint2 Ant2 PowerDet        6400
CalPoint2 Ant2 PowerConstant   386662 (0x5e666 5.9000)
CalPoint2 Ant2 PowerRate       229 (0x00e5 0.0034943)
CalTemp                        40
TempOffsetRate                 590 (0x024e 0.0090027)
PowerDetReadPeriod             4000000
```

3.2.5 Monitoring Tx Power Calibration

It is possible to monitor the power offset as determined by the tx power detector calibration algorithm (i.e. the power offset compensation). Table 3 shows these registers. PowerDetCalOffsetAnt1 is the power offset for antenna 1 (i.e. the amount of power offset that needs to be applied to a requested transmit power to achieve the correct output at the antenna port). The PowerDetCalOffsetAnt1 is updated whenever the power detector is read for a transmission. The PowerDetCalEnable is an enable flag. When it is low, the temperature based calibration is used. When it is high, the power detector calibration is used.

Table 3 – Power Det Calibration Registers

Num	Register Name	Quant	Description
61	PowerDetCalOffsetAnt1	S23Q8	Power cal offset Ant1 as determined by power detect(S23Q8 format)
62	PowerDetCalEnableAnt1		Enable bit for Power detect calibration offset Ant1
63	PowerDetCalOffsetAnt2	S23Q8	Power cal offset Ant2 as determined by power

			detect(S23Q8 format)
64	PowerDetCalEnableAnt2		Enable bit for Power detect calibration offset Ant2
65	PowerDetCalExtraDrivePowerAnt1	S23Q8	Extra power offset that is applied to txpower when using powerdet calibration (S23Q8 format), for Ant1
66	PowerDetCalExtraDrivePowerAnt2	S23Q8	Extra power offset that is applied to txpower when using powerdet calibration (S23Q8 format), for Ant2
67	PowerCalMode		Power calibration mode 0 = off, 1 = temperature only power cal, 2 = power detector (use temp cal until 1st valid power detector is received)

These registers are accessible via the register interface. To read the individual registers:

- llc reg r 0 <reg_num>

To read the complete bank:

- llc reg r 0 <reg_num>

To overwrite these register values

- llc reg w 0 <reg_num> <new_value>

The PowerDetCalExtraDrivePower registers are further described in Section 3.4.

3.2.6 Recalibrating Tx Power Calibration

To re-calibrate an MK5 variant (a board based upon MK5 but may have different transmit power behaviour), it is necessary to determine the measured power to power detector relationship. This can be done by connecting the MK5 variant to an external power meter and collating measured transmit powers with the measured power detector value. To read the power detector value of a transmission, the command “llc txphylast” can be used. Note however it is necessary to transmit slightly slower than once per second or to decrease the PowerDetReadPeriod to be less than the selected frame transmission rate.

```
root@MK5:~# llc txphylast
                                  Radio A    Radio B
Rate ID                                10          0
Length (Bytes)                       1038          0
Antenna                                 1          0
Power (half dBm steps)                 44          0
Ant 1 WISPA Gain                       18          0
Ant 1 Baseband Gain                 35693          0
Ant 1 Power Detect                   8128          0 <- Power detector value here
Ant 2 WISPA Gain                        0          0
Ant 2 Baseband Gain                     0          0
Ant 2 Power Detect                      0          0
```

When performing these measurements, it is important to vary both transmit power and frequency. Note the frame length needs to be large enough such that the power detector value can be read (at least 8 symbols in length). Once a plot is achieved, then the two-line model (Figure 2) can be applied, selecting a model which minimises the error in tx power.
In addition, the measured power to power detector relationship should be calculated over temperature variation, and the temperature dependency determined and compensated for, as described in Section 3.2.2.

3.3 Per Antenna Tx Power Offsets

The MK5 provides the ability to alter the offset transmit power of each antenna path via register control. These register settings represent the board level attenuation present from the PA to the antenna port. These registers are ONLY used when the radio is placed in temperature based calibration or no calibration. They are NOT used when the tx power detector based calibration is employed. When using the tx power detector, it is possible to manipulate the output power via registers using the extra drive registers, described in Section 3.4.

There are two registers provided.

- PowerCalOffsetPCBAnt1
- PowerCalOffsetPCBAnt2

Both parameters are in S7Q8 format, which means a value of 256 corresponds to 1 dB attenuation. The SAF5x00 firmware has the following default register settings.

Table 4 – Default PowerCalOffsetPCB Register Settings

PCB Load	PowerCalOffsetPCBAnt1	Ant1 Offset	PowerCalOffsetPCBAnt2	Ant2 Offset
0 to 2	0	0.0 dB	-384	-1.5 dB
3	-384	-1.5 dB	-384	-1.5 dB
4 to 7	-128	-0.5 dB	0	0.0 dB

These registers are accessible via the register interface. PowerCalOffsetPCBAnt1 is register 40 of bank 0 and PowerCalOffsetPCBAnt2 is register 41 of bank 0. To read the individual registers:

- llc reg r 0 40
- llc reg r 0 41

To overwrite these register values

- llc reg w 0 40 <new_value>
- llc reg w 0 41 <new_value>

3.4 Extra Drive Power

The MK5 provides two extra registers which control the output power of each antenna output.

- PowerDetCalExtraDrivePowerAnt1
- PowerDetCalExtraDrivePowerAnt2

These registers can be used to boost or attenuate the output power on each individual antenna.
These registers are ONLY used for when using the Tx power detection calibration. They have no effect when using the temperature based calibration or when calibration is disabled. They are applied when a tx power detection update is performed for the corresponding antenna. They effectively adjust the PowerDetCalOffsetAnt1 and PowerDetCalOffsetAnt2 registers to achieve higher or lower output powers.

Both registers are in S23Q8 format which means a value of 256 = 1dB of extra drive output power. PowerDetCalExtraDrivePowerAnt1 is register 65 of bank 0 and PowerDetCalExtraDrivePowerAnt2 is register 66 of bank 1. To read the individual registers:

- llc reg r 0 65
- llc reg r 0 66

To overwrite these register values

- llc reg w 0 65 <new_value>
- llc reg w 0 66 <new_value>

Both registers have a default value of 0.

4 RSSI Calibration

Calibration of the receive signal strength indicator (RSSI) across temperature is yet to be implemented on the MK5. However programmable registers are available which apply a fixed offset to the RSSI values for each antenna.

Table 5 – RSSI Registers

Bank	Num	Register Name	Quant	Description
1	14	RSSIOffsetAnt1	Signed Int	Offset (in dB) that is applied to the RSSI measurement for Ant1
1	15	RSSIOffsetAnt2	Signed Int	Offset (in dB) that is applied to the RSSI measurement for Ant2

These registers are accessible via the register interface. To read the individual registers:

- llc reg r 1 14
- llc reg r 1 15

To overwrite these register values

- llc reg w 1 14 <new_value>
- llc reg w 1 15 <new_value>

5 References

[1] CohdaMobility MKx Radio LLCremote API Specification, CWD-MKx-0208-MKxAPISpecification.pdf