

# Phonak FM offset protocol

## 1. Protocol and background information

The protocol is based on the fact that the 10dB advantage setting of the FM receiver results in a transparent behaviour below the transmitter kneepoint, i.e. below 70–75dB SPL (cf. Fig. 1).

All measurements are done in FM+M mode, but only one signal path is being tested at a certain moment.

Nomenclature:

**FM(+M)65** means a measurement with 65 dB SPL input to the FM microphone and the hearing instrument microphone muffled

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| Step   | Comment / FAQ   |
|--|---|
| <b>1. Measurement requirements</b>   |   |
| 1.1. System of hearing instrument, audio shoe, FM receiver and FM transmitter as used by the customer.   | In the following we refer to Campus S and MiniMicrophone MM8 in position omni.  |
| 1.2. Audio test equipment  |   |
| 1.3. The FM receiver should be programmed at its default value (10dB FM advantage) as a starting point.  | 10dB FM advantage is the factory pre-set value.   |
| 1.4. FM Successware and FM Programming Interface   |   |
| 1.5. The hearing instrument should be programmed / fitted as used by the customer.   | We want to determine/adjust the FM advantage for the system such as it is used by the customer.   |
| 1.6. The only exception is to disable noise cancelling and feedback management within the hearing instrument as pure-tone stimuli are used.  | Pure tones may be recognized as noise or feedback by many noise and feedback cancelling algorithms, which makes reliable measurements impossible. |
| 1.7. Stimuli should preferably some kind of broadband noise (speech shaped) as long as individual frequency results can be obtained; if broadband stimuli are not available use pure tone sweeps |   |

| Step   | Comment / FAQ  |
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| <b>2. Set-up HI and MLxS</b>   |  |
| 2.1. Program hearing instrument to desired use settings and switch off noise canceller and feedback manager (and automatic program selection). Set VC to reproducible level (leave attached with programming cable). |  |
| 2.2. Attach appropriate audio shoe to hearing instrument.  |  |
| 2.3. Attach MLxS to audio shoe ensuring correct pin orientation.   |  |
| 2.4. Ensure that the DPAl='yes' or DPAl='no' selection in the FM Successware is done correctly and programmed into the MLxS.   | <p>Will depend on the hearing instrument.</p> <p>If you select 'no' when the instrument has DPAl, the incoming FM signal may be unexpectedly strong and even distorted.</p> <p>If you select 'yes' when the HI does not have DPAl the receiver switch will not change between FM and FM+M.</p> |
| 2.5. Ensure that the 10dB FM advantage (default value) is programmed into the MLxS.  | 10dB FM advantage is the factory setting.  |
| 2.6. Switch on MLxS to FM+M and set hearing instrument to usual M program (DPAl='no') or program FM+M (DPAl='yes').  |  |
| 2.7. Verify that the transmitter is switched on and the MLxS is synchronized.  | <p>This is true for all measurements (make sure that the FM receiver does not go into squelch or sleep mode, by keeping the transmitter active).</p>   |

| Step   | Comment / FAQ                             |
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| <b>3. Baseline hearing instrument measurement</b>  |   |
| 3.1. Verify that the transmitter is switched on and the MLxS synchronized, but switch the transmitter microphone off (MM8) or, alternatively, muffle the transmitter microphone.<br>Do not switch the transmitter off. |   |
| 3.2. Attach hearing instrument to 2cc coupler and place into test box.   |   |
| 3.3. Run curve with 65dB SPL input.<br>-> (FM+)M65 tracing.  |   |
| 3.4. Perform discrete frequency signal analysis, calculate the average for preferably 3 different frequencies (like 750, 1000, 2000 Hz) or evaluate response at 1kHz or another speech frequency.                      |   |
| <b>4. Set-up for FM measurement</b>  |   |
| 4.1. Verify that the transmitter is switched on and synchronized to MLxS.  |   |
| 4.2. Move 2cc coupler together with hearing instrument out of text box.  |   |
| 4.3. Keep MLxS in FM+M and hearing instrument in usual M program (DPAI='no') or program FM+M (DPAI='yes').   | Exactly the same configuration as in 2.6. |
| 4.4. Muffle the hearing instrument's microphone.   |   |
| 4.5. Set Campus S microphone MM8 to omni position.   |   |
| 4.6. Place MM8 in test box in test position.   |   |

| Step  | Comment / FAQ  |
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| <b>5. Transparency test</b>   |  |
| 5.1. Run curve with 65dB SPL input into transmitter microphone situated in test box.<br>-> FM(+M)65 tracing.  | The +10dB advantage setting leads to transparency below the transmitter kneepoint.<br>The FM response at 65dB SPL for a 10dB FM advantage setting is the same as the MIC response at 65dB SPL, because 65dB SPL is below the kneepoint of the transmitter. – cf. Fig. 1. |
| 5.2. Perform discrete frequency signal analysis, calculate the average for preferably 3 different frequencies (like 750, 1000, 2000 Hz) or evaluate response at 1kHz or another speech frequency. |  |
| 5.3. Compare (FM+)M-65 tracing to FM(+M)-65 tracing. They should be very close within 2dB or overlay.   |  |
| 5.4. The offset is the difference between both measurements.  |  |
| <b>6. Offset correction / balancing</b>   |  |
| 6.1. This step is performed if the transparency test indicates a need for an offset correction.   |  |
| 6.2. Offset = FM(+M)65 minus (FM+)M65   | For the offset calculation you may use one single value at e.g. 1kHz but preferably a mean value of several frequencies.   |
| 6.3. If offset <+2dB and >-2dB: do not change anything, the FM advantage is within $\pm 1$ dB at its target value.  |  |
| 6.4. If offset value is larger than that correct for the FM offset.   |  |

| Step      |  | Comment / FAQ  |
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| 6.5.      | Open FM Successware and correct the indicated FM advantage in FM+M (there is only one slider for DPAI='yes' HI) by the decibel difference obtained in the transparency test. | <p>Attention: compression / expansion</p> <p>You may want to check the I/O characteristics of the HI as programmed.</p> <p>An x dB increase in input level does not result in same change in output level.</p> <p>Run an I/O of the hearing instrument in (FM+)M (output SPL as a function of input SPL in order to know the compression or expansion behaviour of the HI in the interesting range).</p> |
| 6.6.      | Place the hearing instrument with attached MLxS into the FM Programming Interface and program the offset.  |  |
| <b>7.</b> | <b>Cross-check transparency</b>  |  |
| 7.1.      | Repeat step 5 to cross-check for transparency.   |  |
| 7.2.      | If not within $\pm 2$ dB repeat 6 and 7.   |  |
| <b>8.</b> | <b>FM advantage</b>  | Not possible to measure – believe us it's around 10dB  |
| 8.1.      | Run curve with 80dB SPL input into transmitter microphone situated in test box.  |  |
| 8.2.      | Compare FM(+M)80 to (FM+)M65.  | <p>You will obtain a higher output for FM(+M)80 than for (FM+)M65, provided the MPO is not limiting for input signals between 65 and 80dB SPL. The measured difference is NOT the FM advantage experienced by the user in position FM+M. Therefore this step of the protocol is optional.</p>  |

| Step                 | Comment / FAQ |
|----------------------|---------------|
| <b>9. MPO Safety</b> |               |

9.1. Run curves with 90dB SPL input into transmitter microphone situated in test box, and with 90 dB SPL input to hearing instrument microphone  
 FM(+M)90  
 (FM+)M90

Make sure the output does not exceed MPO targets

|  |
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| <b>10. FM Advantage and listening objectives</b> |
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10.1. The recommended FM Advantage of 10 dB is a compromise between different listening objectives. To hear the main speaker (the FM signal) one would need a higher FM Advantage, to hear oneself and other talkers close by (through the hearing instrument microphone), one would need a lower FM Advantage. In specific cases one can choose a different FM Advantage than 10 dB.

## 2. Annex

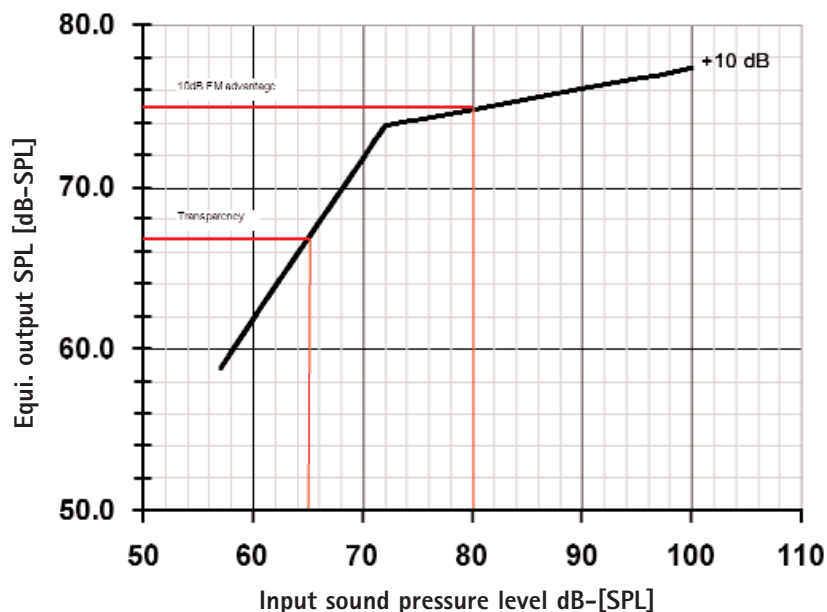


Fig. 1: Overall I/O of a Phonak transmitter combined with a Phonak MLxS type receiver.

# FM Advantage Worksheet

## FM Advantage: Phonak Offset Protocol (POP)

1. (FM+)M 65 - match target
2. FM(+M) 65 - transparency with HA only, difference is offset
3. (FM+)M 90 - ensure response does not exceed MPO targets
4. FM(+M) 90 - ensure response does not exceed MPO targets
5. FM(+M) 80 - crosscheck with realistic inputs (optional)

Make sure that all measurements are done in FM+M mode (including those in HA only), with the transmitter always active to avoid sleepmode in the receiver. Make sure the receiver has been programmed correctly for 'DPAI=yes' or 'DPAI=no' (default) hearing instruments.

| Real Ear Measures                   | @750Hz | @1kHz | @2kHz |   |            |
|-------------------------------------|--------|-------|-------|---|------------|
| FM(+M)65 curve (dB)<br>(start here) |        |       |       |   |            |
| Minus<br>(FM+)M65 curve<br>(dB)     | -      | -     | -     |   |            |
| Equals<br>FM Offset (dB)            | =      | =     | =     | Add the offset values in this row<br>and divide by 3. → | ∅ Offset = |

### AVERAGE OFFSET VALUES:

1. If your offset value is between  $-/+ 2$ dB, you are done! The default  $+10$ dB of receiver gain is appropriate. Your FM response is transparent at equal inputs, so when you have a loud (FM input) simultaneously with a softer (conversational input through the HA mic) input, true FM advantage will be achieved!
2. If your FM offset is equal to or more than  $+2$ dB you will need to reduce the FM gain level in the receiver by the offset value. This will make it transparent with the HA at equal inputs.
3. If your FM offset is equal to or less than  $-2$  dB, you will need to increase the FM internal gain setting by the offset value to make it transparent at equal inputs.