APPLICATION NOTE

Multiple-Tone Settings for IMUX VF Modules (Voice Cards)

IMUX analog modules (voice cards) are occasionally employed to transmit multi-tone signals. Such signals, for example generated by RFL 9745, consist of several different audio signals present at the same time.

The input and output levels of the voice cards should be programmed as follows to accommodate multiple tones:

1. Determine the level of individual audio signals fed into the input of the voice card. This can be obtained from the system documentation, such as 9745 setup information.
2. Determine the peak level of composite signal. Refer to instructions included in this document.
3. Determine transmitter attenuator setting. Refer to “Attenuator Settings” table in the instruction manual for the particular voice card. The transmitter attenuator should be set for the level corresponding to the peak composite signal.
4. Determine receiver attenuator setting. Refer to “Attenuator Settings” table in the instruction manual for the particular voice card. The receiver attenuator should be set for the level corresponding to the same peak composite signal as in the transmitter. This will create a 0db (no-loss) channel.
5. Settings are complete.

Calculating peak level of composite signal.

A. All individual tones have identical levels.

The peak composite signal is a multiple of individual tones: it is double of each of two tones, or quadruple of each of four tones, etc.

Therefore:

For composite consisting of 2 tones:

Peak level [dBm] of composite =

= level of each tone [dBm] + 6 dB (double)

For composite consisting of 3 tones:

Peak level [dBm] of composite =

= level of each tone [dBm] + 9.5 dB (triple)

For composite consisting of 4 tones:

Peak level [dBm] of composite =

= level of each tone [dBm] + 12 dB (quadruple)

B. Individual tones have different levels.

The peak composite signal is a sum of individual tones.

a. Determine voltage level of each of the individual signals.
P is signal power in dBm, ^ represents "power of" operator.
Note that circuit impedance is ignored, as it cancels out in subsequent operations.

Vtone [Volts reference] = 10^ (Ptone / 20)

b. Add voltages of individual tones to arrive at peak composite level.

Vcomposite [Volts reference] = Vtone1 + Vtone2 + ….

c. Convert composite voltage back to dB power.

Pcomposite [dBm] = 20 log (Vcomposite)

Example.

a. Set up a VF-5 module for a 4-channel RFL 9745.
Signal consists of 4 tones at –15dBm each.

b. All 4 tones are identical.

Peak composite signal is: –15dBm + 12dB = –3dBm.

d. "Attenuator Settings" table in the instruction manual indicates a TX attenuator setting of 16dB for –3dBm input. See attached table.

e. "Attenuator Settings" table in the instruction manual indicates an RX attenuator setting of 13dB for –3dBm output. See attached table.

f. Program the TX=16dB and RX=13dB settings to obtain a no-loss channel capable of transmitting the composite signal.

Example: VF-5 Attenuator Settings for –3dBm in and –3dBm out.

Transmit Level In	Transmit Attenuator Setting
+5 dBm	24 dB
+4 dBm	23 dB
+3 dBm	22 dB
+2 dBm	21 dB
+1 dBm	20 dB
0 dBm	19 dB
-1 dBm	18 dB
-2 dBm	17 dB
-3 dBm <<<	16 dB <<<<<
-4 dBm	15 dB
-5 dBm	14 dB
-6 dBm	13 dB
-7 dBm	12 dB
-8 dBm	11 dB
-9 dBm	10 dB
-10 dBm	9 dB
-11 dBm	8 dB
-12 dBm	7 dB
-13 dBm	6 dB
-14 dBm	5 dB
-15 dBm	4 dB
-16 dBm	3 dB
-17 dBm	2 dB
-18 dBm	1 dB
-19 dBm	0 dB

Receive Level Out	Receive Attenuator Setting
-14 dBm	24 dB
-13 dBm	23 dB
-12 dBm	22 dB
-11 dBm	21 dB
-10 dBm	20 dB
-9 dBm	19 dB
-8 dBm	18 dB
-7 dBm	17 dB
-6 dBm	16 dB
-5 dBm	15 dB
-4 dBm	14 dB
-3 dBm <<<	13 dB <<<<<
-2 dBm	12 dB
-1 dBm	11 dB
0 dBm	10 dB
+1 dBm	9 dB
+2 dBm	8 dB
+3 dBm	7 dB
+4 dBm	6 dB
+5 dBm	5 dB
+6 dBm	4 dB
+7 dBm	3 dB
+8 dBm	2 dB
+9 dBm	1 dB
+10 dBm	0 dB

RFL

353 Powerville Road
Boonton Township, NJ 07005-9151
Tel. 973-334-3100
e-mail customerservice@rflelect.com
www.rflelect.com