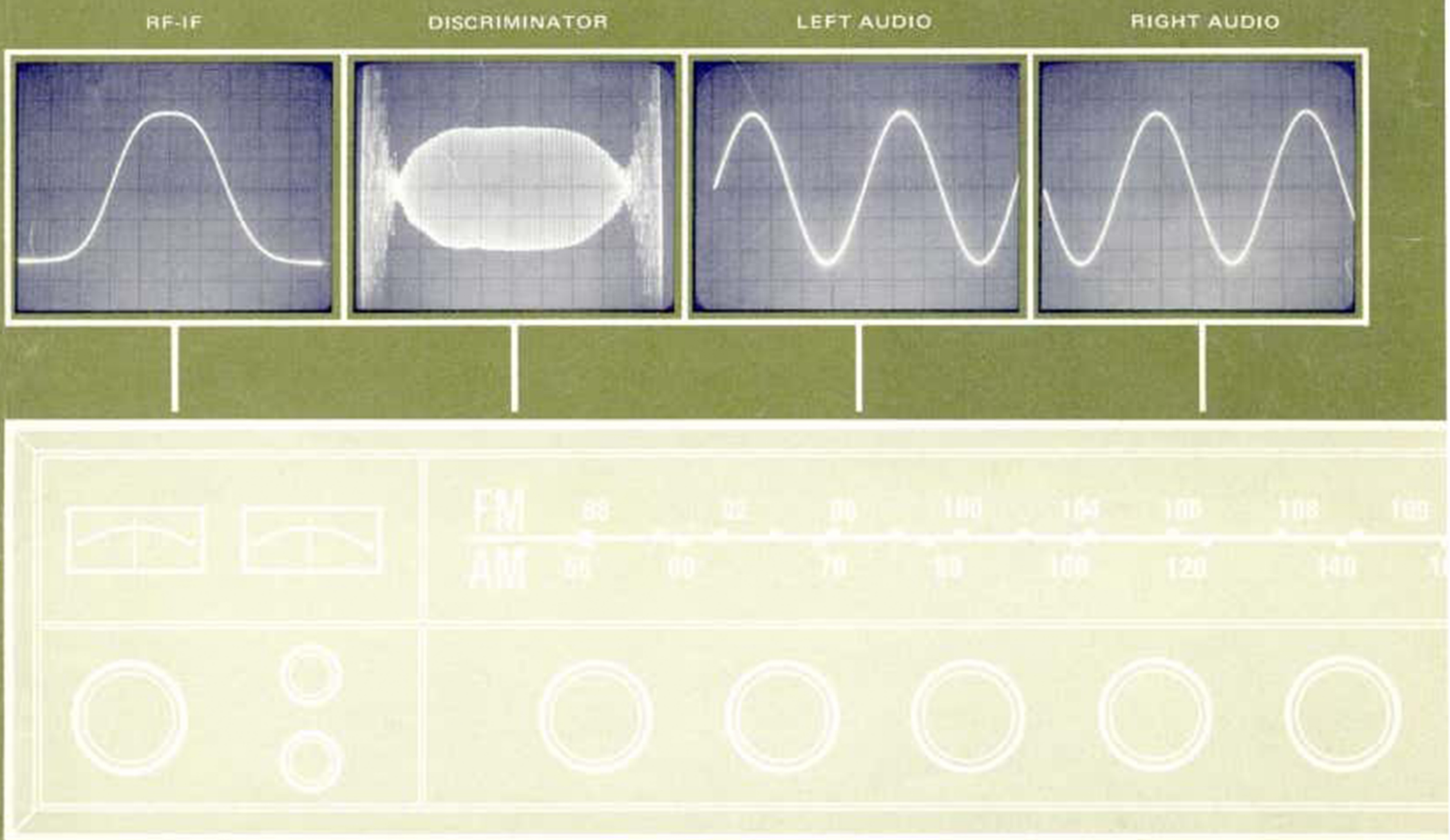
# how to align stereo receivers

## EASILY AND QUICKLY WITH THE MODEL 1000A FM ALIGNMENT GENERATOR

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# Alignment Chart

**Read Detailed Alignment Procedures for additional description and techniques.**

| STEP | ADJUSTMENT PROCEDURE | SYSTEM CONNECTIONS | MODEL 1000A CONTROLS | RECEIVER CONTROLS | ALIGN FOR |
|---|---|---|---|---|---|
| 1 | **IF ALIGNMENT** Preferred Method | Figure 1. | **Function:** Dual Sweep<br>**RF Level:** 100 µV or less<br>**Frequency:** Tune to receiver<br>**Sweep Width:** 600 kHz<br>**Phase:** To superimpose scope forward and reverse traces. | **Mode:** Monaural, FM<br>**Muting:** Off<br>**Tuning:** To a dead spot in the fm band | Maximum amplitude and symmetry of the scope display. |
| 1A | **IF ALIGNMENT** Alternate Method | Figure 3. | **Function:** Monaural<br>**RF Level:** 100 µV or less<br>**Frequency:** Tune to receiver<br>**Input:** Left<br>**Osc Level:** 100% modulation | Same as above. | Sync scope on INT OSC output of 1000A. Reduce RF level below limiting. Align for max audio output. |
| 2 | **PEAK TUNING METER ADJUSTMENT** | — | Same as IF alignment method used except set RF Level to 30 µV. | Same as above. | Fine tune 1000A to center of IF bandpass. Reduce SWEEP WIDTH to zero (or set OSC LEVEL to zero). Adjust for peak reading on meter. |
| 3 | **LOCAL OSCILLATOR ALIGNMENT** | — | Use accurate 90 MHz and 106 MHz sources. | **Mode:** Monaural, FM<br>**Muting:** off<br>**Tuning:** 90MHz for coil slug, 106MHz for trimmer capacitor. | Complete any mechanical dial adjustments first. Align local oscillator for dial accuracy (coil slug at 90 MHz, trimmer capacitor at 106 MHz). |
| 4 | **RF ALIGNMENT** Preferred Method | Figure 1. | **Function:** Dual Sweep<br>**RF Level:** 3 µV to 30 µV<br>**Frequency:** Tune to receiver<br>**Sweep Width:** 600 kHz<br>**Phase:** To superimpose scope forward and reverse traces. | Same as above. | Maximum amplitude and symmetry of the scope display. Adjust coils at 90 MHz, capacitors at 106 MHz. |
| 4A | **RF ALIGNMENT** Alternate Method | Figure 3. | **Function:** Monaural<br>**RF Level:** 100 µV<br>**Frequency:** Tune to receiver<br>**Input:** Left<br>**Osc Level:** 100% modulation | Same as above. | Sync scope on INT OSC output of 1000A. Reduce RF LEVEL below limiting. Align RF coils at 90 MHz, trimmer capacitors at 106 MHz for max audio output. |
| 5 | **FM DETECTOR ALIGNMENT** Preferred Method | Figure 2. | **Function:** Dual Sweep<br>**RF Level:** 1000 µV<br>**Frequency:** Tune to receiver<br>**Sweep Width:** 250 kHz<br>**Phase:** To superimpose scope forward and reverse traces. | **Mode:** Monaural, FM<br>**Muting:** Off<br>**Tuning:** To a dead spot in the fm band | Tune for symmetrical pattern with flat top. Reduce SWEEP WIDTH to zero and adjust secondary to center zero-tune meter if receiver has one. Increase SWEEP WIDTH to 250 kHz and adjust primary for optimum flatness. |
| 5A | **FM DETECTOR ALIGNMENT** Alternate Method | Figure 3 except TAPE RCDR OUTPUT of receiver is connected to Total Harmonic Distortion Analyzer. | **Function:** Monaural<br>**RF Level:** 1000 µV<br>**Frequency:** Tune to receiver<br>**Input:** Left<br>**Osc Level:** 100% modulation | Same as above. | Adjust secondary to center zero-tune meter, if receiver has one. Adjust primary for a minimum reading on the distortion analyzer. |
| 6 | **STEREO DECODER SCA TRAP** | Figure 3 SCA test point to scope vertical. | **Function:** SCA<br>**RF Level:** 1000 µV<br>**Frequency:** Tune to receiver<br>**Osc Level:** 30% modulation | **Mode:** Stereo, FM<br>**Muting:** Off<br>**Tuning:** To a dead spot in the fm band | Adjust for minimum 67 kHz on scope. Note. Connection to receiver must be ahead of de-emphasis circuit. |
| 7 | **STEREO DECODER 19 kHz COILS** | Figure 3. Recorder out to scope vertical. | **Function:** Stereo<br>**RF Level:** 1000 µV<br>**Frequency:** Tune to receiver<br>**Pilot Level:** 8%<br>**Input:** Left or Right<br>**Osc Level:** 100% modulation | Same as above. | Gradually decrease pilot level while adjusting coils for max separation. |
| 8 | **STEREO DECODER 38 kHz COIL** | Same as above. | **Same as above except:**<br>**Pilot Level:** 10%<br>**Input:** L – R | Same as above. | Adjust for maximum amplitude of scope display. |
| 9 | **STEREO DECODER** Stereo Separation Control | Same as above. | **Same as above except:**<br>**Input:** Left or Right | Same as above. | Adjust for maximum separation. |

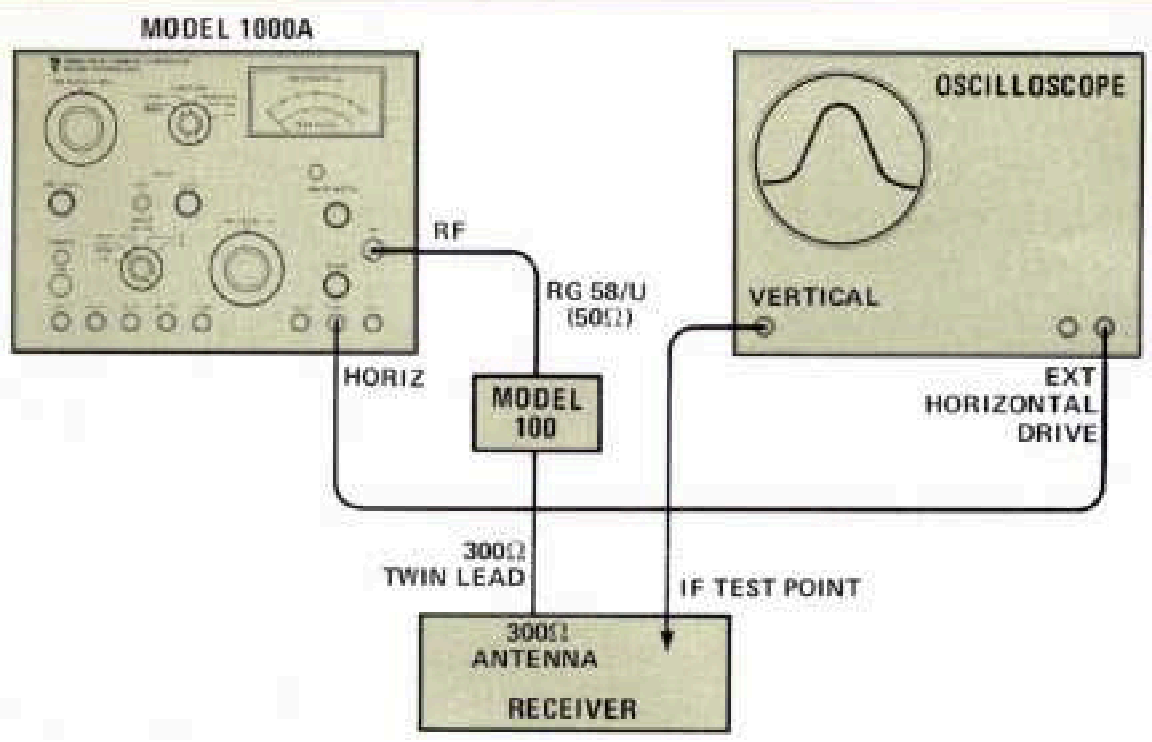



Figure 1. RF and IF Sweep Alignment

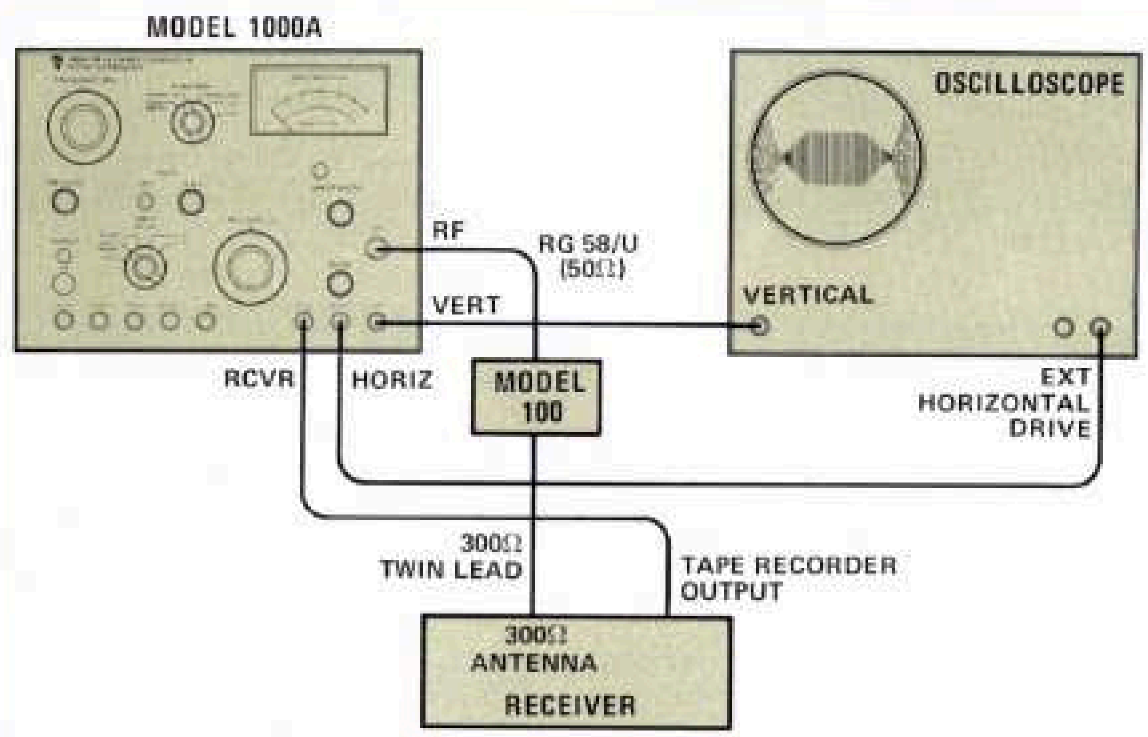



Figure 2. Discriminator Alignment

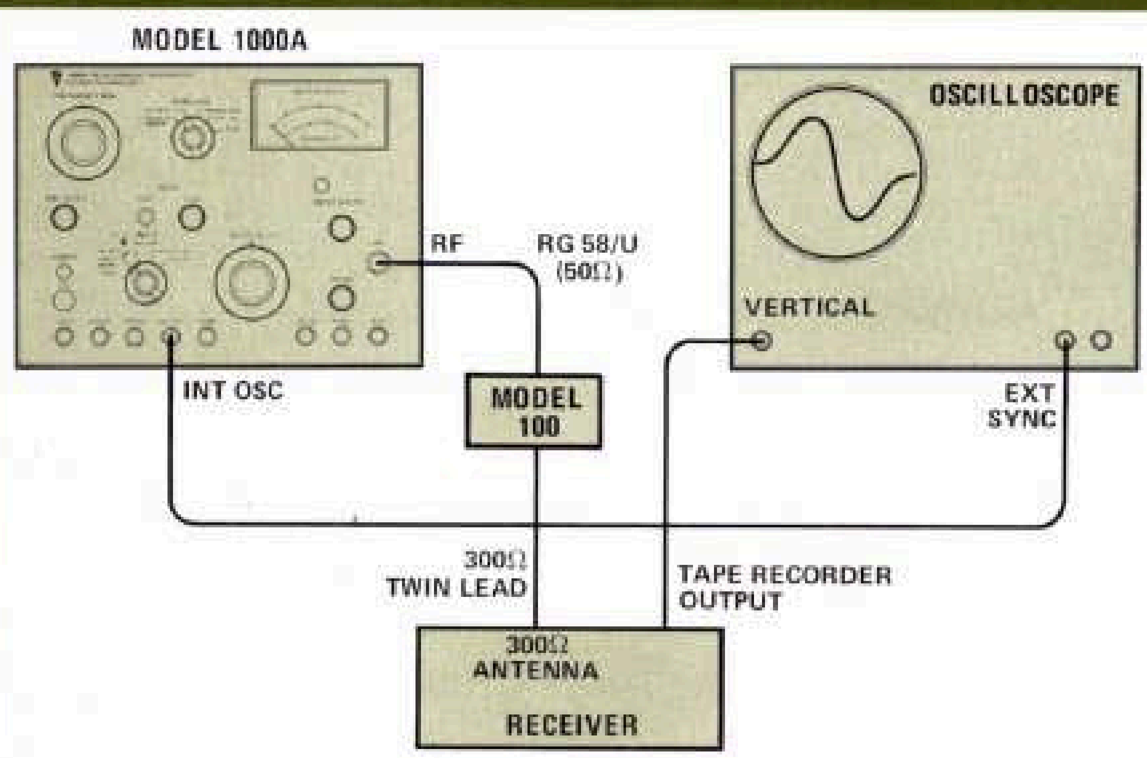



Figure 3. Alternate RF, IF and Detector Alignment
Stereo Decoder Alignment

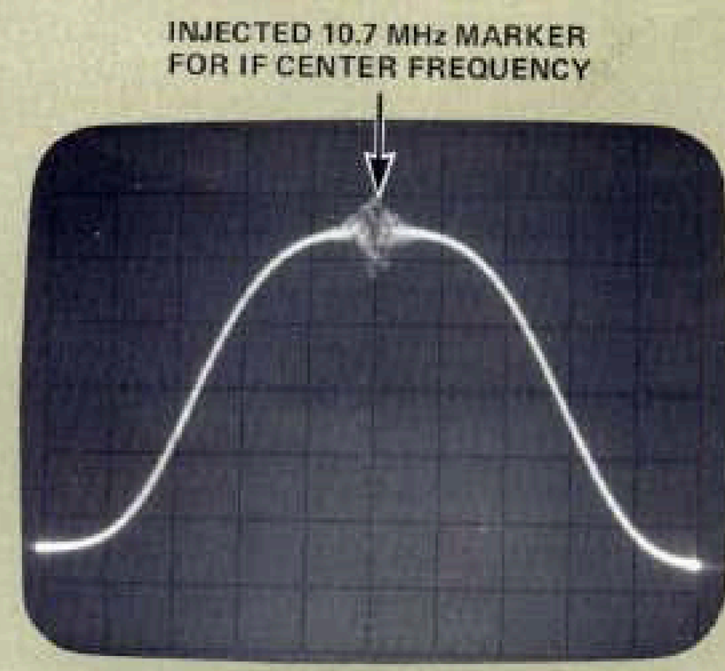



Figure 4.
RF and IF Response

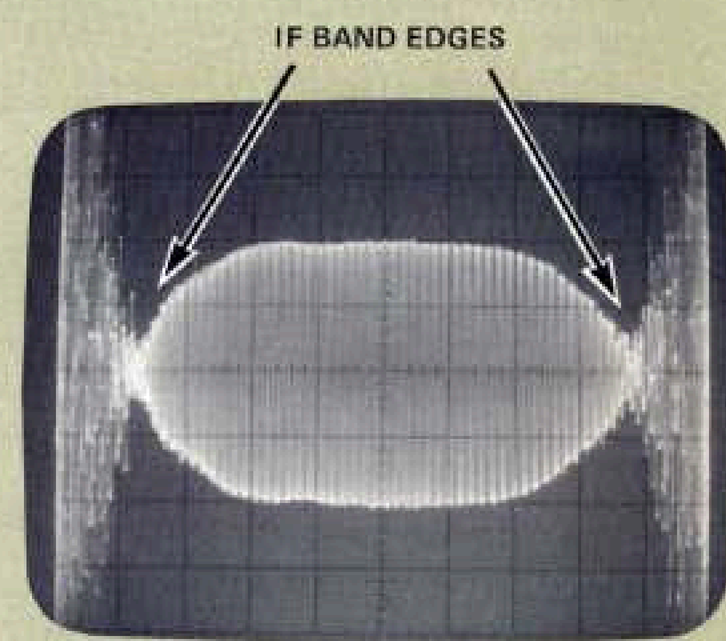



Figure 5.
Dual Sweep Response (Detector Alignment)

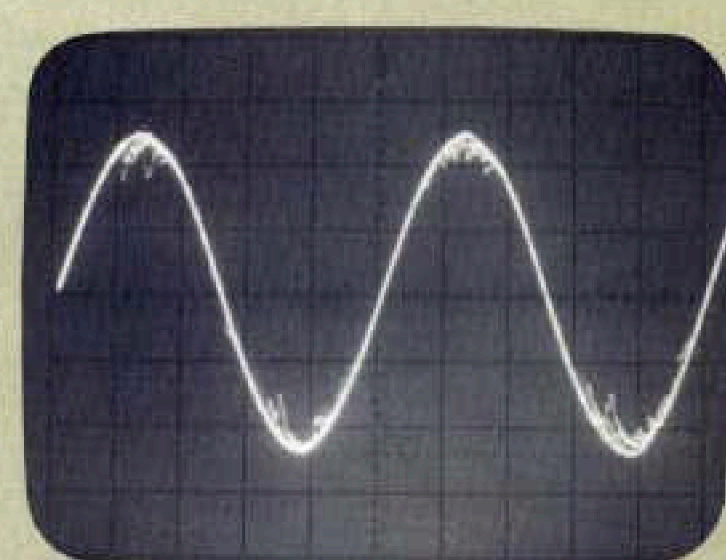


Figure 6.
Three Percent Distortion and Noise

# Detailed Alignment Procedures

## GENERAL GUIDELINES

**We have found the following alignment methods to be generally applicable. It should be noted, however, that some receiver circuits have special requirements. Receiver manufacturers' service manuals should be consulted whenever possible.**

### A Few General Rules

- You can quickly and easily determine the receiver's condition without even removing its covers. Spending a few minutes making some performance measurements before proceeding with alignment is well worthwhile. If, for example, you find the receiver has good sensitivity you can skip the RF and IF sections in your alignment. Receiver performance measurements are described on page 7 of this brochure.

- In all of the tests the Model 1000A RF output is connected to the receiver 300Ω antenna input. Use a suitable matching network such as the *Sound Technology* Model 100 Matching Transformer. When this unit is used, the generator RF LEVEL dial reads directly the microvolts applied to the receiver antenna terminals.

- Where frequencies in the fm band are specified, they should be considered to be approximate frequencies. Adjustments should be made at dead spots in the fm band to avoid the possibility of misleading results due to interference from a local fm station.

- The receiver should be set in the Monaural mode for all procedures except the stereo decoder adjustments.

- Receiver muting circuits should be disabled.

- It is best to perform the alignment in the order shown in this brochure.

## IF ALIGNMENT

### Preferred Method – Sweep Alignment

Sweep alignment is the preferred method for tuning a receiver's IF strip because it is fast and usually produces the best results. Sweep alignment requires probing the IF. Some receivers provide an IF test point; however, when one is not provided, a detector probe must be used to observe the band-pass or an alternate method for IF alignment must be used. Information on detector probes is available from *Sound Technology*.

Connect the probe to the receiver at the input to the amplifier driving the discriminator. The lower the impedance to ground at this point, the better. Probing a low impedance point minimizes the probe's detuning effect.

Connect the 1000A and a scope to the receiver as in Figure 1 and set the receiver and the 1000A controls as described in the Alignment Chart, Step 1. Adjust 1000A frequency dial to locate IF sweep pattern in the center of the scope trace. Adjust PHASE control to make forward and reverse traces on the scope coincide. A typical response pattern is shown in Figure 4. The pattern will be inverted in some receivers. Adjust the IF circuits for maximum amplitude and symmetry of the pattern. Vary 1000A RF LEVEL up and down to see if the pattern maintains its shape and make a compromise adjustment if necessary.

### Notes

1. If the IF strip will not come into alignment or if for some reason you suspect the IF frequency is too far away from 10.7 MHz (greater than 0.5 MHz), you can inject a signal from a 10.7 MHz crystal oscillator into the IF strip and obtain a beat frequency marker as shown in Figure 4. Inject the 10.7 MHz marker signal near the mixer stage and adjust the 1000A frequency to center the marker on the scope trace. Then remove the 10.7 MHz and turn off the crystal oscillator so it won't interfere with the alignment. Information on crystal oscillators is available from *Sound Technology*.

2. Some receivers will have fixed-tuned IF's. IF alignment is unnecessary in such a case, of course, but the discriminator and peak-tuning meter (if there is a separate adjustment) must be aligned to the fixed IF center frequency, as described later under FM Detector Alignment.

### Alternate Method 1 – Monaural Alignment

Connect the equipment as shown in Figure 3. Set the receiver and 1000A controls as described in the Alignment Chart, Step 1A. A scope is used to observe audio output from the receiver. An AC (audio) voltmeter can also be used.

Reduce 1000A RF LEVEL until the audio on the scope drops approximately 20% in amplitude. The receiver is now operating below limiting.

Fine tune the 1000A for maximum audio and adjust the IF circuits to peak the audio on the scope. If you run into limiting, reduce RF LEVEL again.

### Alternate Method 2 – Alignment by Peak-Tuning Meter

Set the equipment up as described in Alternate Method 1. First tune the 1000A for a peak on the meter, making sure the RF LEVEL is low enough to get a sensitive peak, probably below 30 $\mu$V, then align the IF strip for a peak meter reading. If the receiver has a peak-tuning meter adjustment, it should be aligned together with the IF's.


## PEAK-TUNING METER ADJUSTMENT

If the receiver has a separate tuned circuit for the peak-tuning meter, immediately after IF alignment and without changing receiver or 1000A frequency, align the tuned circuit for a peak meter reading. If the IF's were aligned by the sweep method, reduce SWEEP WIDTH to zero before doing the alignment. RF LEVEL is set below 30 μV. If there is a gain adjustment on the meter circuit, set full scale at 10mV RF LEVEL unless manufacturer's instructions specify otherwise.

If the receiver has fixed-tuned IF's proceed to FM Detector Alignment before adjusting the peak-tuning meter. After adjusting the detector, reduce SWEEP WIDTH to zero and adjust the peak-tuning meter circuits.

## LOCAL OSCILLATOR ALIGNMENT FOR RECEIVER DIAL ACCURACY

Correct any slippage in the dial mechanism and, using a local station or crystal oscillator, tune the receiver to a signal source of known frequency near 90 MHz. Adjust the local oscillator coil for an accurate receiver dial reading.

Repeat near 106 MHz. Tune local oscillator trimmer capacitor for an accurate dial reading.

Repeat these steps until effects of high and low end interaction are eliminated. Information on dial calibration standards is available from *Sound Technology*.

## RF ALIGNMENT

### Preferred Method – Sweep Alignment

Connect equipment as in Figure 1, and set the receiver and 1000A controls as described in the Alignment Chart, Step 4. With the receiver and generator set near 90 MHz, adjust all the rf (excluding local oscillator) coils for maximum amplitude and symmetry of the scope display. If maximum amplitude does not coincide with optimum symmetry it may be necessary to go back and touch up the IF circuits.

With the receiver and generator set near 106 MHz, adjust the rf trimmer capacitors for maximum amplitude and symmetry of the scope display.

Repeat these steps to eliminate the effects of interaction.

### Alternate Method – Monaural Alignment

Connect equipment as in Figure 3, and set the receiver and 1000A controls as described in the Alignment Chart, Step 4A. Tune 1000A FREQUENCY and receiver to 90 MHz to obtain an audio waveform as in IF Alignment, Alternate Method 1. Reduce RF LEVEL below limiting and adjust coils in tuner (except local oscillator) to maximize the amplitude of the scope waveform.

Repeat at 106 MHz and adjust the tuner's trimmer capacitors.

Repeat these steps until interaction is eliminated.

# FM DETECTOR (DISCRIMINATOR) ALIGNMENT

### Preferred Method – Dual Sweep Alignment

Connect the equipment as shown in Figure 2, and set the 1000A and receiver controls as described in the Alignment Chart, Step 5. Tune the 1000A to obtain the scope pattern shown in Figure 5.

An ideal receiver will display a DUAL SWEEP pattern with a rectangular center portion. The bandwidth of the flat portion of the top should be at least 250 kHz. Align discriminator primary and secondary to approach this ideal as nearly as possible. Use a wide SWEEP WIDTH to optimize the symmetry of the receiver's band edges and get an overall picture of the receiver's performance. The center portion of the display drops to zero at the IF band edges. A wide, symmetrical pattern means the receiver will be easy to tune. Set sweep width to 250 kHz to make final primary (usually the bottom slug) adjustments to optimize flatness of display. Vary RF LEVEL up and down to see if the pattern maintains its shape. Make a compromise adjustment if necessary.

### Notes

1. Receiver distortion can be calculated directly from the DUAL SWEEP display as follows:

Set SWEEP WIDTH to 150 kHz and calculate distortion as follows:

Peak I.M. Distortion =

$$\frac{\text{Peak-to-peak variation of the pattern top}}{\text{Average peak-to-peak pattern height}} \times 100\%$$

$$\text{Total Harmonic Distortion} = \frac{\text{Peak I.M. Distortion}}{5} (\pm 25\%)$$

2. Any sharp spikes in the bandpass are probably due to an oscillating IF stage, the stereo decoder (put the receiver in mono), or interference from a local station.

3. If the display drops suddenly to zero near the band edges, it is probably an audio stage clipping. This may not be significant, since we are sweeping the receiver over a wider band than it must normally handle. Narrowing SWEEP WIDTH should avoid this effect.

4. For receivers with fixed-tuned IF's, adjust the 1000A FREQUENCY so the IF center frequency corresponds with the center of the scope sweep display. The DUAL SWEEP pattern will fall to zero at the edges of the IF bandpass (Figure 5). Fine tune the 1000A until the middle portion of the DUAL SWEEP pattern is centered on the scope. Leave the 1000A tuned to this frequency while adjusting the discriminator and peak-tuning meter. If the discriminator is badly misaligned, some preliminary adjustment may be required while finding the IF center frequency.

5. For receivers with a zero-center-tuning meter, fine tune 1000A for the IF band center, as in note 4 above. Reduce SWEEP WIDTH to zero. Adjust discriminator secondary to zero the zero-center-tuning meter or to obtain zero volts at manufacturer's specified discriminator output test point. Set SWEEP WIDTH to 250 kHz, and adjust discriminator primary (usually the bottom slug) for optimum flatness of the DUAL SWEEP pattern.

### Alternate Method – Monaural Alignment

In this method, the alignment is done while observing distortion of the receiver's audio output on a Distortion Analyzer rather than using DUAL SWEEP. The set-up is covered in the Alignment Chart, Step 5A. This method can lead to erroneous results because the alignment does not take into consideration what is happening on the band edges. The receiver may not respond well to modulation peaks and may be difficult to tune because of an unnecessarily abrupt change in linearity at one or both of the band edges. Keep in mind, also, that the alignment can be no better than the distortion of the generator being used. A low reading on the Distortion Analyzer means that the receiver has been aligned to have distortion equal to that of the generator, but with opposite phase. The 1000A has less than 0.1% distortion. If a generator with 1% distortion is used, a "perfect" alignment will result in the receiver having 1% distortion.

# STEREO DECODER ALIGNMENT

Connect the equipment as shown in Figure 3. Set the 1000A and receiver controls as described in the Alignment Chart, Step 6.

### SCA Trap

Connect the scope to a test point in the stereo demodulator between the SCA trap and the de-emphasis circuits. If a test point is not designated by the manufacturer, connect to the secondary of the 38 kHz transformer. Use a low capacitance probe. Adjust the SCA trap for minimum 67 kHz on the scope.

### Note

Some manufacturers may have other SCA adjustments at fixed frequencies. In this case switch the 1000A to MONAURAL with the INPUT switch on EXT. Connect an external audio oscillator to the 1000A LEFT input and adjust the oscillator output for approximately 30% modulation. Then make the adjustments prescribed by the receiver manufacturer.

### 19 kHz Coils

Set up 1000A and receiver as described in the Alignment Chart, Step 7. There are two methods for aligning the 19 kHz coils. In this first method the 1000A PILOT LEVEL is gradually lowered while continuing to adjust for maximum separation as observed on the scope. Most receivers work down to 5% pilot. Be sure the left and right channels are not reversed while making this adjustment.

The second method requires connecting the vertical input of the scope to a test point in the receiver at the output of the final 19 kHz amplifier. The coils are then adjusted for maximum output of the 19 kHz.

### 38 kHz Coils

With 1000A and receiver settings as described in the Alignment Chart, Step 8, adjust the 38 kHz transformer for maximum audio output on the scope display. This adjustment provides minimum distortion and is not dependent on the setting of the receiver's Stereo Separation Control.

### Stereo Separation Control

Adjust the receiver's separation control for maximum separation. A compromise adjustment may be required if left-to-right and right-to-left separations are unequal.

### Note

If you go back and adjust 19 or 38 kHz coils to improve separation, you will introduce audio distortion.

# Create Business with Tuner Clinics

Run an efficient and effective tuner clinic with the 1000A. Using the 1000A, you can fully test a receiver without even removing its covers. The 1000A is so fast to use that you can test a customer's receiver while he waits. Here are 5 important measurements that can be made in less than 5 minutes.

## BANDWIDTH

___ kHz measured at 300 $\mu$V input for 20% peak intermodulation distortion.

(This bandwidth is read directly in kHz on the 1000A front panel meter with SWEEP WIDTH increased until 20% curvature of the DUAL SWEEP pattern shows. This is an unconventional measurement but it tells a lot about the receiver. If bandwidth is less than about 250 kHz the receiver will be difficult to tune and distortion will be quite noticeable on modulation peaks. Here's where you see if the receiver needs alignment! For instance, if the pattern tilts in the center, the discriminator primary needs adjustment.)

## DISTORTION

___% total harmonic distortion at 1000 $\mu$V input.

(This can be measured with DUAL SWEEP. Set SWEEP WIDTH to 150 kHz, RF LEVEL to 1000 $\mu$V and measure peak intermodulation distortion as described on page 6 under Discriminator Alignment. Divide by 5 to get equivalent THD with an accuracy of better than 25%.

If a THD analyzer is used, set the 1000A on MONAURAL, 400 Hz, 100% modulation. If a 1 kHz modulating frequency is used, the THD reading will be 20% to 36% low depending on whether the dominant harmonic content is second or third order. This is caused by the de-emphasis in the tuner.)

## SENSITIVITY

___ $\mu$V measured at ___ MHz for 30 dB quieting.

(Set 1000A on MONAURAL, 400 Hz, 100% modulation RF LEVEL 1000 $\mu$V. Observe receiver audio output on a scope. Reduce 1000A RF LEVEL until noise appears approximately as shown in Figure 6 (3% noise): Read sensitivity on the RF LEVEL dial.

A more precise definition (IHF) requires the use of a THD analyzer. While measuring audio distortion, reduce RF LEVEL until analyzer reading increases to -30 dB (3% distortion plus noise).)

## NOISE

___ dB residual noise below 100% modulation at 1000 $\mu$V input (IHF Standard).

(First obtain a reference reading on an AC Voltmeter with 1000A on Monaural, 100% modulation, RF LEVEL 1000 $\mu$V. Then switch 1000A to CW. Read residual noise (dB below reference level) on the Voltmeter.)

## SEPARATION

___ dB Right, ___ dB Left, 1 kHz, 100% modulation.

(1000A on STEREO, INPUT switch on LEFT then on RIGHT.)

Furnish your customer a record of the results of tests made on his receiver. Reprint the form below for use as a clinic test card.

**TUNER CLINIC**

*YOUR LETTERHEAD*

UNIT NO. ____________

CLAIM TAG ____________

DATE ____________

CUSTOMER NAME ______________________________

ADDRESS ______________________________

CITY ____________ STATE ____________ ZIP ____________

BRAND ____________ MODEL ____________ SERIAL ____________

BANDWIDTH ____________ kHz Measured at 300 $\mu$V input for 20% peak intermodulation distortion.

DISTORTION ____________ % total harmonic distortion at 1000 $\mu$V input.

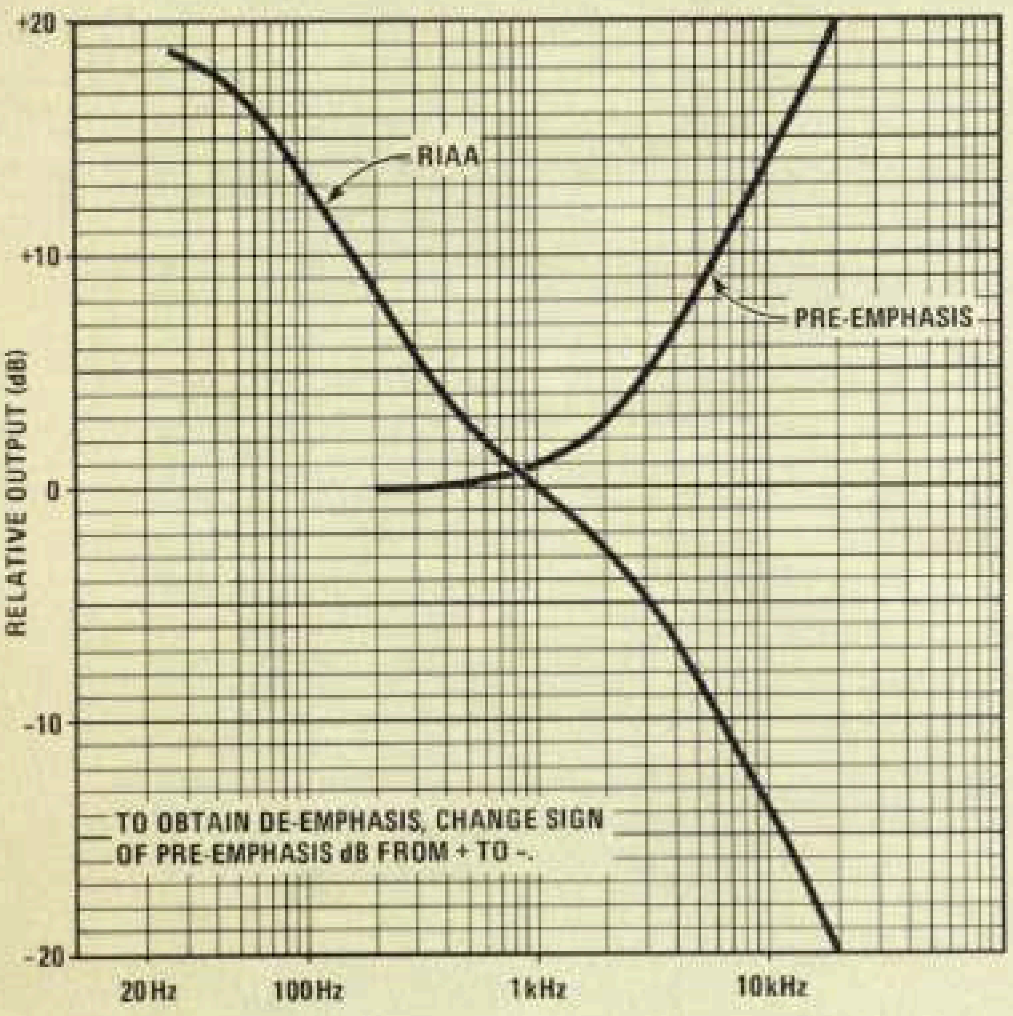
SENSITIVITY ____________ $\mu$V measured at ________ MHz for 30 dB quieting.

NOISE ____________ dB residual noise below 100% modulation at 1000 $\mu$V input.

SEPARATION ____________ dB Right ________ dB Left, 1 kHz, 100% modulation.

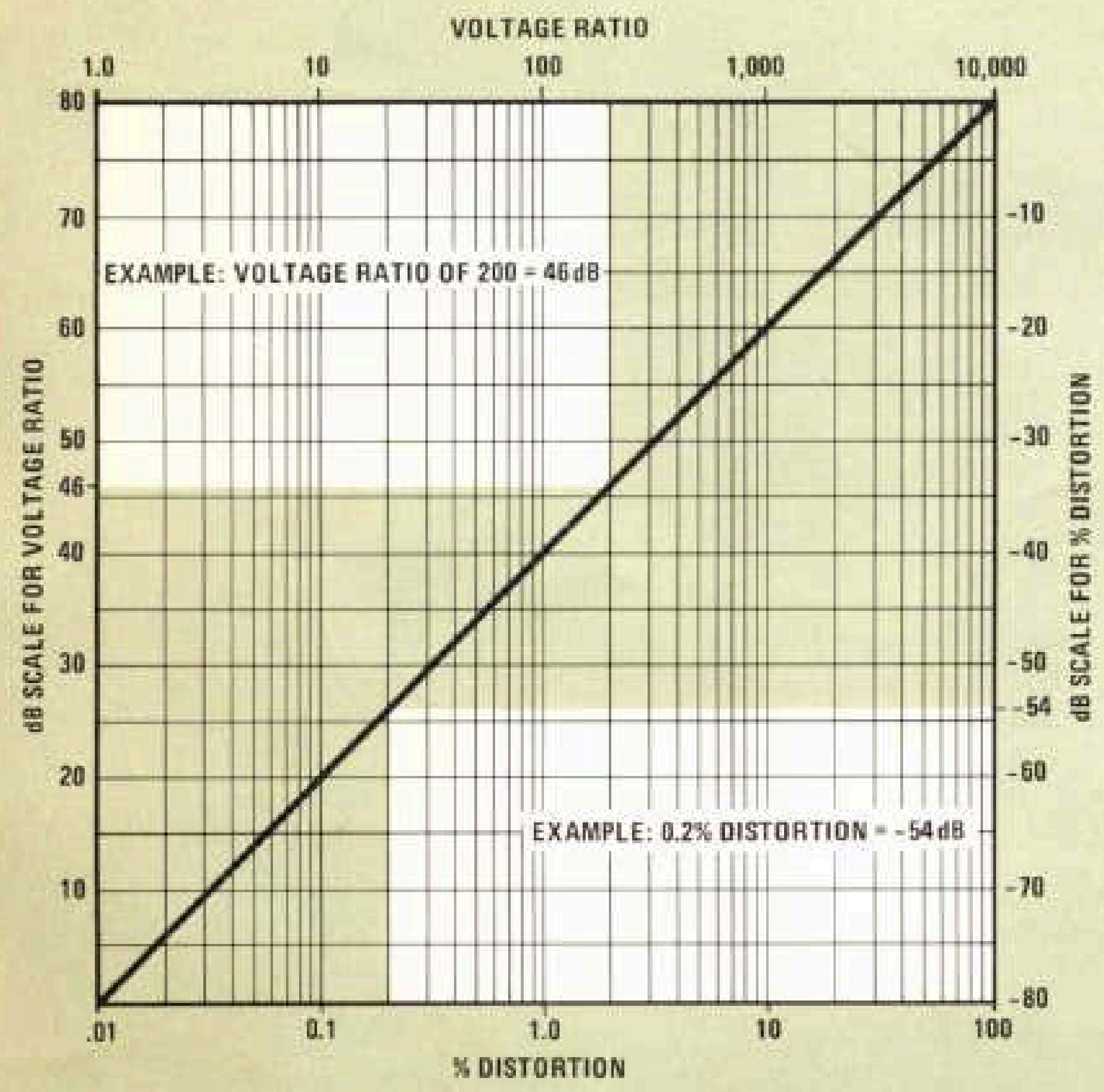
Technician ____________

# Conversion Charts

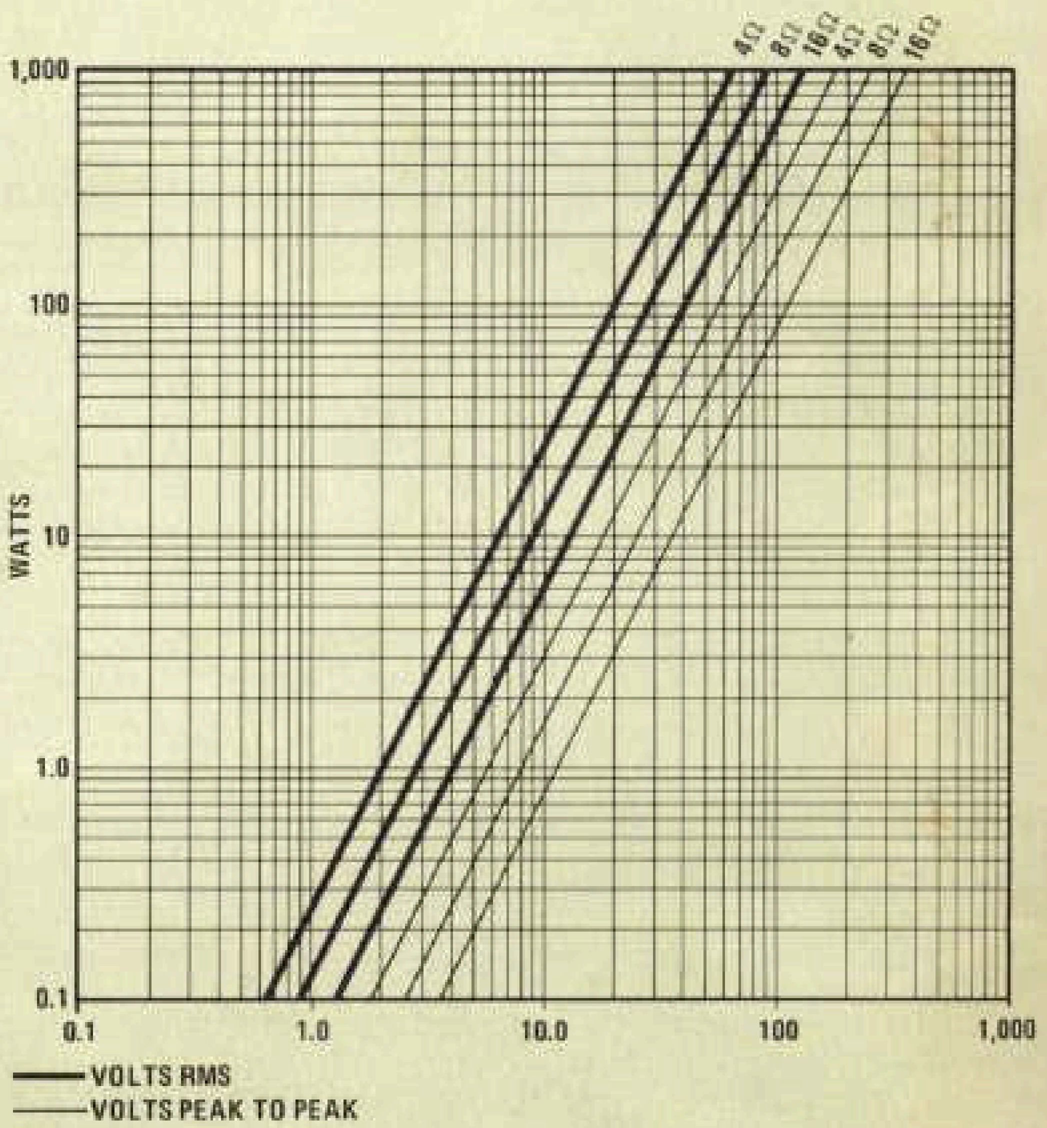



EQUALIZATION CURVES

| | RIAA (dB) | DE-EMPHASIS (dB) | PRE-EMPHASIS (dB) |
|---|---|---|---|
| 15 kHz | -17.17 | -17.07 | +17.07 |
| 14 | -16.64 | -16.49 | +16.49 |
| 13 | -15.95 | -15.86 | +15.86 |
| 12 | -15.28 | -15.18 | +15.18 |
| 11 | -14.55 | -14.45 | +14.45 |
| 10 | -13.75 | -13.66 | +13.66 |
| 9 | -12.88 | -12.78 | +12.78 |
| 8 | -11.91 | -11.82 | +11.82 |
| 7 | -10.85 | -10.75 | +10.75 |
| 6 | -9.62 | -9.54 | +9.54 |
| 5 | -8.23 | -8.16 | +8.16 |
| 4 | -6.64 | -6.58 | +6.58 |
| 3 | -4.76 | -4.77 | +4.77 |
| 2 kHz | -2.61 | -2.76 | +2.76 |
| 1000 | 0 | -.87 | +.87 |
| 700 | +1.23 | -.45 | +.45 |
| 400 | +3.81 | -.15 | +.15 |
| 300 | +5.53 | -.09 | +.09 |
| 200 | +8.22 | -.04 | +.04 |
| 100 | +13.11 | -.01 | +.01 |
| 70 | +15.31 | .00 | .00 |
| 50 | +16.96 | .00 | .00 |
| 30 | +18.61 | .00 | .00 |




dB CONVERSION




VOLTAGE-TO-POWER CONVERSION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