AUDIO LEVEL DEVICES

*by Thomas R. Haskett** — Part Two.
A discussion of compressors and averaging devices, their principles and features.

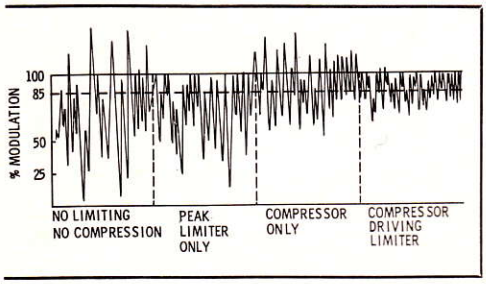

Fig. 1. Compressor and limiter effects.

Although a limiter can protect a transmitter against audio peaks, too much limiting (say, 20 to 30 db) can increase distortion to 3 or 4%. The limiter can't do anything about low passages, below its limiting threshold. During many programs low passages would be lost to some listeners if only a limiter were employed. To overcome such difficulties, the compressor was developed. The names are different—compressor, compressor - expander, AGC amplifier, averaging device, etc.—but the function is about the same in each case. Dynamic range is lessened by compressing peaks and expanding low passages.

Compressor Operation

While a limiter establishes a ceiling for peaks, as seen in Fig. 1, it doesn't affect low-level signals. The compressor pulls up these lows, but its peak limiting isn't too good. Fig. 2 shows why. The limiter's operating point (average signal level at input) is at or slightly above threshold, seldom higher. But the compressor normally works in the middle of its slope; since this slope often covers 30 db of input variation, greater-than-average signals are compressed more, and lesser-than-average signals are compressed less. The result is shown in Fig. 1, and it's precisely this latter action that gives the compressor an advantage over the limiter. However, this feature has a disadvantage, too. The compression ratio is low—roughly 3:1 for a compressor, compared with 10:1 or more for a limiter. Thus, a compressor's output is much more variable than a limiter's. Also, the attack and release times of a compressor determine its action. If the limiter-type dual-recovery circuit is used, gain reduction and return are functions of the program material, and the action is essentially that of a limiter. But if long time constants are used, the unit is essentially an average-level device, since short peaks don't affect the gain. Where time-constant switching is provided, its positions are usually marked **dual** and **average.**

Circuit Action

The basic circuit is shown in Fig. 3; note the similarity to the limiter circuit. V1-V2 is a variable-gain stage, generally a 6386 twin triode operated in push-pull. V3-V4 constitute a fixed-gain, push-

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Table of compressor and

Model	Attack Time msec	Release Time sec	Compr. Ratio	Input Level dbm	Output Level dbm	Gain db	Noise Level dbm	Frequency Response
Collins 26J-1 Auto-Level	11 or 62	0.9 or 5.2	1.6:1 to 5:1	−26 to +30	−24 to +30	41	−50	±1.0 db 50 to 15,000 cps
Collins 356E-1				−54 to +6	0 to +36	54		
Fairchild 666	30	0.3 to 30	2.8:1	−5 to +15	+13 to +25	30	−65	±1.0 db (40 db) 20 to (compr.) 15,000 cps
Fairchild 666A								
Fairchild 663	40	0.3 to 7.0	3:1	−35 to +25	+22	None	None*	±0.5 db 20 to 30,000 cps
Gates M-5167 Sta-Level	25	1.0 to 12	3.3:1	−44 to +24	+8 to +24	62	−45	±1.0 db (30 db) 30 to (compr.) 15,000 cps
GE BA-9-A Uni-Level	11 or 62	0.9 or 5.3	1.6:1 to 5:1	−54 to +6	0 to +36	54	−50	±1.0 db (30 db) 50 to (compr) 15,000 cps
GE BA-9-B Uni-Level								
ITA AGC-1A	25	5.0	7:1	−37 to +13	+20 to +34	57	−50	±1.0 db (50 db) 20 to (compr.) 20,000 cps
Langevin AM-5301 Leveline	0.1 to 11	0.5 to 3.0	1.6:1 to 5:1	−70 to −6	+26 or +37	53	−57	±0.5 db 20 to 20,000 cps
Quindar QCA-2	250	....	10:1	−52 to −18	−10	40	....	±3.0 db 250 to 4000 cps
RCA BA-25A	12.5	1.0	2.1:1 to 6.2:1	−80 to −25	−10 to +30	70	−46	±1.0 db 30 to 15,000 cps

*Passive circuit—no generated noise.

pull output stage, from which a portion of the signal is rectified by V4, the AGC diode. The resulting DC furnishes operating bias for the input stage. Unlike the limiter, which has a **fixed** threshold, the compressor threshold is usually **variable.** A pot across the B+ allows selection of various delay voltages to be applied to the diode cathode. No control voltage can be generated until the output signal exceeds this threshold voltage, of course. By changing the threshold, the input tube operating point is altered, and this, in turn, produces a different compression ratio. Hence, the range commonly found is 2:1 to 6:1. And this action must not be confused with the **signal** operating point; the latter is obtained by setting the signal-input level to the first stage. Between the diode and the signal-input an RC network provides attack and release times. As we've mentioned, this is often variable. Because the compression ratio is low, circuitry is less elaborate than for a limiter. Since compressors are always used **ahead** of limiters, and frequently at the console output, or even at an earlier point where levels are low, size is generally small compared with limiters. All compressors listed in Table 1 will match 600 ohms in and out.

Disadvantage

While the compressor overcomes one difficulty associated with the limiter, it introduces another. If a loud passage is followed by a very soft one, or a pause of several seconds duration, the compressor raises the gain. Only there's nothing to amplify but room noise, air-conditioner noise, and perhaps even tube noise! And if an old ET is being played, or a dusty LP, the surface noise gets expanded and listeners hear needle scratch in all its glory. This can be partially overcome by using less compression, but it defeats the purpose of employing an averaging device. (The solution to this problem will be covered in Part IV.)

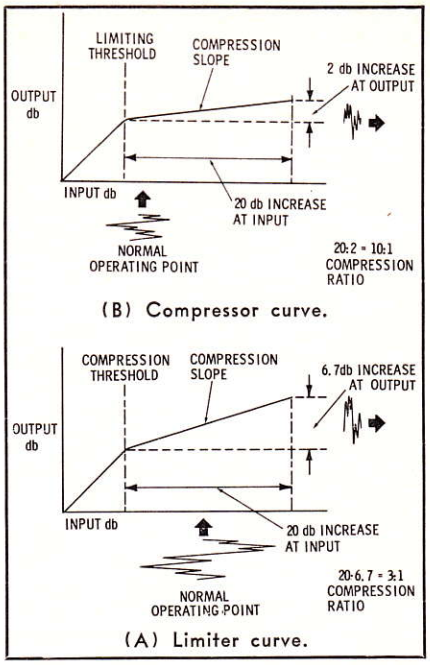

Fig. 2. Limiter and compressor curves.

Operating Practice

Operating practice today is to locate the compressor between the main console and the limiter, the limiter then driving the transmitter, as in Fig. 4A. What happens is that the gross variations in level by announcer-operators are corrected somewhat, and the limiter then only has to protect against peaks, and smooth out few of those. This hookup is especially desirable if a telephone line separates the studio and transmitter, since the compressor can then deliver a less erratic signal to that line, maintaining a better signal-to-noise ratio. Also, harmonic distortion divides between the compressor and the limiter; you get less with both than either alone.

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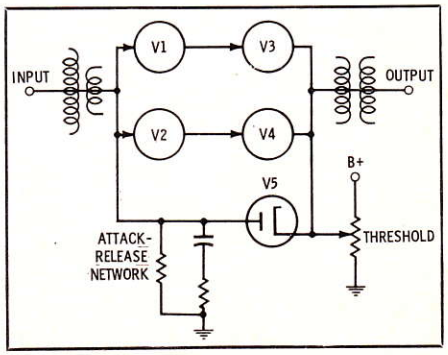

Fig. 3. Basic compressor circuit.

averaging device specifications.

Harmonic Distortion	Compr. Meter	Dimensions Width	Height	Depth	Price	Model
2.0% (30 db) 50 to (compr.) 15,000 cps	Yes	19"	5 1/4"	9"	$275.00	Collins 26J-1 Auto-Level
	No	3"	5 3/8"	9"	130.00	Collins 356E-1
0.4% (40 db) 25 to (compr.) 15,000 cps	Yes	19"	3 1/2"	6"	495.00	Fairchild 666
					399.00	Fairchild 666A
Below 0.3%	Yes	1 1/2"	7"	4 1/2"	158.00	Fairchild 663
1.0% (30 db) 50 to (compr.) 15,000 cps	Yes	19"	5 1/4"	7"	249.00	Gates M-5167 Sta-Level
2.0% (30 db) 50 to (compr.) 15,000 cps	No	3 1/2"	5 3/4"	10 3/4"	140.00	GE BA-9-A Uni-Level
		19"	3 1/2"	7 1/2"	200.00	GE BA-9-B Uni-Level
1.0% (25 db) 35 to (compr.) 20,000 cps	Yes	19"	5 1/4"	7 3/4"	225.00	ITA AGC-1A
Below (25 db) 1.0% (compr.)	No	2 5/8"	3"	10 1/4"	225.75	Langevin AM-5301 Leveline
10.0% (10 db) 150 to (compr.) 2500 cps	No	1 3/4"	1 3/4"	6"	90.00	Quindar QCA-2
Below 1.0% 30 to (30 db) 15,000 (compr.)	No	8 3/8"	4 21/32"	12 1/2"	225.75	RCA BA-25A

Audio Level Devices

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Another attractive job for the compressor is shown in Fig. 4B, in series with a permanent, unattended remote line, and preferably **at** the remote location. The wide variations in level at the scene will be converted into a more easily-managed signal before being put on the TelCo line.

The **ducker,** or **automatic fader,** is a favorite at stations with semi-automated operation. The turntable or tape output is mixed with the announce mike preamp output, setting the announce mike gain from 10 to 15 db higher than the turntable; this combined signal is then fed to the compressor. (This can be done at the console.) When it's desired to announce over music, the announcer simply opens his mike—the compressor will pull down the combined signal, the music being 10 or 15 db below voice.

Some stations use a mixerless studio operation for announcers, wherein it's only necessary to start and stop turntables and tape machines and open the mike switch. All gain-riding is done by the averaging device, and the motor-start switches trigger relays which open and close the signal channels from the turntables. As illustrated in Fig. 4C, no console is actually needed, since the preamp outputs can be tied together by fixed pads and the common leg fed to the compressor. For a simple setup involving only two turntables (or an automatic disc player) and one or two cartridge machines, such an arrangement simplifies controls for nontechnical announcers. Some stations even go so far as to dub all music on tape; then three cartridge machines and a mike are all the announcer needs to operate.

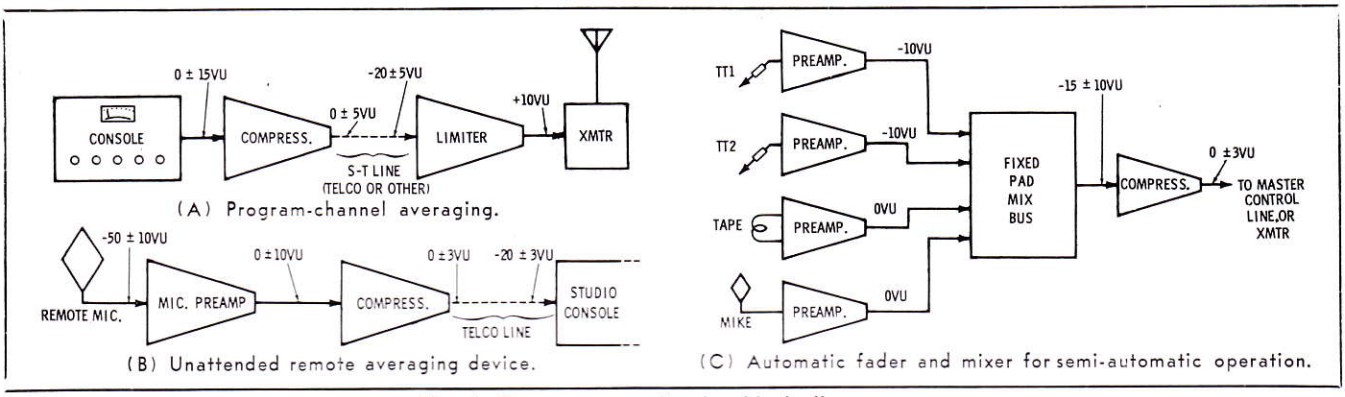

Fig. 4. Compressor application block diagrams.