

C-QUAM[®] AM STEREO BY MOTOROLA



MOTOROLA INC.

A World Leader in Electronics

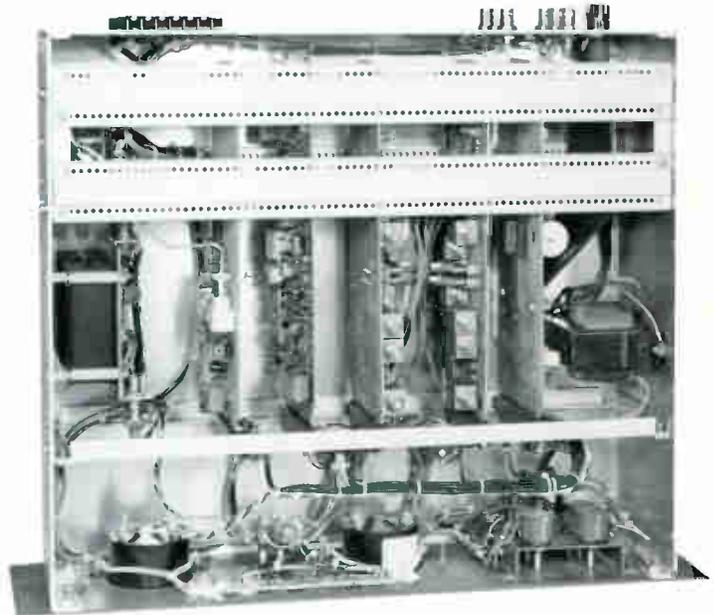
AM STEREO • GENERAL DESCRIPTION

The name "C-Quam" is derived from the phrase Compatible Quadrature Modulation. This means that the system has the advantages of quadrature modulation for stereo transmission, and is compatible with the hundreds of millions of existing monaural AM radios. In fact, the C-Quam system simply takes the sum of left and right stereo channels (L+R) and directly amplitude modulates the broadcast signal. This is the precise signal that monaural radios were designed to receive.

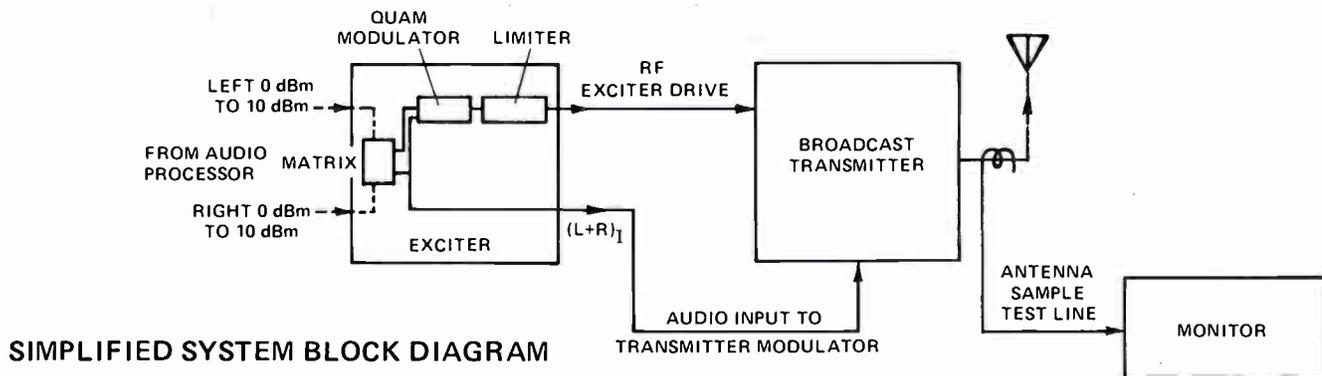
To provide stereophonic information, angle modulation results from straight forward Quadrature Modulation followed by limiting. That is, the monophonic (L+R) provides in-phase modulation while (L-R) provides quadrature phase modulation. The limiter assures constant level exciter drive to the transmitter.

A separate signal, 25Hz pilot tone, is added to the quadrature difference (L-R) signal for indicating the presence of a received stereophonic C-Quam broadcast.

Existing AM broadcast transmitters may be adapted to C-Quam with relatively simple and inexpensive modifications.



CARD CAGE CONSTRUCTION



SIMPLIFIED SYSTEM BLOCK DIAGRAM

SYSTEM SPECIFICATIONS

The following performance is typical closed loop performance of the Exciter operating into the Monitor.

Stereo Separation:

35 dB Minimum from 100Hz to 5kHz

Frequency Response:

L, R 100Hz -- 10KHz \pm 1.0dB

Distortion, Harmonic:

L=R Monaural 0.25% max. at 85% mod.

L=-R Pure Stereo 0.5% max. at 85% mod.

* L,R Single Channel 1.0% max. at 70% mod.

*NOTE: This is equivalent of 140% modulation, 70% envelope modulation, simultaneous with 70% stereo information.

SYSTEM SPECIFICATIONS

EXCITER

RF Output:

Adjustable internally up to 5 watts into 50 ohms

(L+R)_I:

Adjustable under cover on front panel via 10 turn potentiometer up to +16 dBm, 600 ohms balanced.

Stereo-Monaural:

Switched under cover on front panel. Switches L=R for monaural. Stereo, monaural indicated by LED on front panel.

Audio Input:

Right 0 dBm to +10 dBm Balanced 600 ohms
Left 0 dBm to +10 dBm Balanced 600 ohms
Both inputs adjustable with factory installed pad per customer requirement

Meter Functions:

(L+R)_O (L-R)_O Range -20 dB to +3 dB
0 dB = 100% Modulation.

Right, Left:

Meter functions switched at front panel between meters.

Phase Equalization:

Internally adjustable phase equalization is provided to compensate for phase variations in the transmitter chain.

Delay Circuit:

Provides wide band delay for propagation path differences in transmitter.

Night Feature:

A duplicate set of both delay and equalization to allow the exciter to work with either two separate transmitters or two significantly different antenna systems.

Sample Transmitter Output:

A sample transmitter output is provided on the rear. This contains all of the modulation aspects (L+R)_O, (L+R)_I, (L-R)_O. This is provided for diagnostics and comparison of transmitter characteristics vs. exciter characteristics.

Sample transmitter output 2 volts peak to peak into 50 ohms.

MONITOR

RF Input:

Frequency crystal controlled
Input level = 1 volt to 10 volts RMS
Impedance = 50 ohms

Modulation Meters:

Meter range 0 to 140% (-20 dB to +3 dB)
Attenuator range 0 to -50 dB in -10 dB steps
Accuracy at 100% modulation 400 Hz \pm 2%
Meters switchable to + or -

LEFT or (L+R)
RIGHT or (L-R)

Peak Modulation Indicators:

(L+R) Group:

-100% Indicator internally set to flash when modulation exceeds -99%
+125% Indicator internally set to flash when modulation exceeds +124%
Peak Indicator adjustable via thumb wheel switches from 30% to 150%. Modulation

selectable via push button switches + or -.

(L-R) Group:

Negative limit set internally to flash at 1.46 radians or 83.67°.
(L-R) limit set internally to flash when modulation exceeds 99%.
Peak flasher adjustable via thumb wheel switches for 30% to 125%.

Output BNC connectors on rear:

Remote Flashers (L+R)
(L-R)
Remote Meters (L+R)
(L-R)

Left Audio 600 ohms balanced & unbalanced
Right Audio 600 ohms balanced & unbalanced
(L+R)
(L-R)
25 Hz Pilot tone

C-QUAM SUPERIORITY:

- Full coverage in monaural and stereo.
- Maximum compatibility with high quality audio processing and pre-emphasis.
- Full L+R modulation capability (from 125% to -100%) under normal programming conditions.
- Compliance with all FCC requirements.
- Maximum compatibility with existing equipment, including directional antennas.
- Superior stereo performance under adverse signal conditions.
- Minimum of falsing between mono and stereo in fringe areas and no noise bursts at the receiver end.
- Wide acceptance by both broadcasters and receiver manufacturers.

SYSTEMS SUPPORT:

- Installation
- Maintenance
- Decoder IC's
- Engineering assistance to:
 - Broadcasters
 - Generator manufacturers
 - Receiver manufacturers
- Technical service



EXCITER FEATURES

- Extremely low monaural distortion typically less than 0.2% from 20 Hz to 20kHz
- Compact size 5¼" rack space
- Metered (L+R)_I, (L-R)_O, (L+R)_O
- Front panel adjust L+R audio, L+R balance +16 dBm output capability
- Day/Night or transmitter number 1 & 2 option
- + and - negative peak adjustable clipping available

MONITOR FEATURES

- Simultaneous metering of L,R or L-R, L+R
- Adjustable peak flasher from 0 to 150%
- 600Ω balanced output at 0dBm
- Separate outputs for L,R, L+R, L-R, envelope detector, and pilot
- Front panel metering of pilot tone
- Compact size 5¼" rack space
- Front panel metering of transmitter stereo performance
- Pilot tone indicator
- Flasher indication of modulation limits -100%, +125%, L-R limit, C-QUAM neg. limit
- Remote metering and flasher options
- 50 Hz/240V AC version available

For purchase plan or additional information contact:

Dick Harasek
Motorola AM Stereo
1216 Remington Road
Schaumburg, Illinois 60195
Phone (312) 576-2879

OR

Chris Payne
Motorola, Inc.
Suite 200
1776 K. Street, N.W.
Washington, D.C. 20006
Phone (202) 862-1549

AM STEREO

BY
MOTOROLA



THE SYSTEM CHOSEN BY DELCO FOR GENERAL MOTORS VEHICLES

GENERAL DESCRIPTION AM STEREO

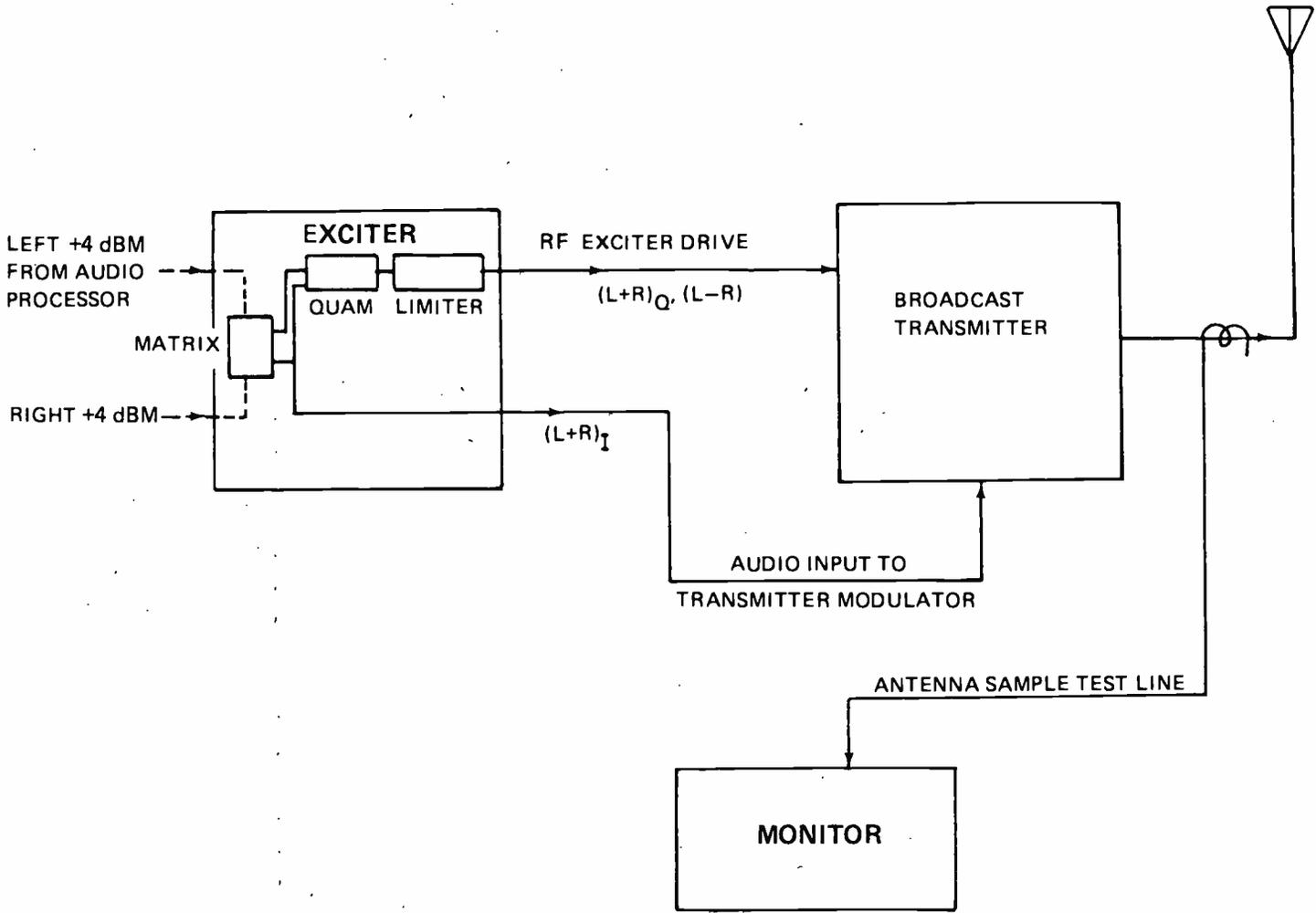
In the system, as in present AM broadcast standards, the angle modulated carrier is amplitude modulated with the sum of the audio information present in the program source. Thus, to a monophonic receiver, the received signal is no different from the signals being received under the present standards. This sum signal is comprised of two signals, left (L) and right (R).

To provide stereophonic information, angle modulation results from straight forward quadrature modulation followed by limiting. That is, the monophonic (L + R) provides in-phase

modulation while (L - R) provides quadrature phase modulation. The limiter assures constant level exciter drive to the transmitter.

A separate signal, 25Hz. pilot tone, is added to the quadrature difference (L - R) signal for indicating the presence of a received stereophonic broadcast.

Existing AM broadcast transmitter may be used with relatively simple and inexpensive modifications.



System Block Diagram

SYSTEM SPECIFICATIONS

The following performance is typical closed loop performance of the Exciter operating into the Monitor.

Stereo Separation: 35 dB Minimum

Frequency Response: L,R 40 Hz -- 15 KHz. \pm 1.0dB

Distortion, Harmonic:

L=R Monaural 0.25% max.,
at 85% mod.

L=-R Pure Stereo 0.5% max.,
at 85% mod.

*L,R Single Channel 0.5% max.,
at 70% mod.

EXCITER

Audio Input:

Right 0 dBm Balanced 600 Ohms

Left 0 dBm Balanced 600 Ohms

Both inputs adjustable with 10 turn potentiometer under cover on front panel.

Meter Functions:

$(L + R)_Q$ $(L - R)$ - 20 dB to + 3 dB

0 dB = 100% Modulation.

Right, Left

Meter functions switched at front panel between meters.

$(L + R)_Q$ and $(L + R)_I$ are switchable under the cover on the front panel to show either at the meter.

RF Output:

Adjustable internally up to 5 watts into 50 ohms

$(L + R)_I$:

Adjustable under cover on front panel via 10 turn potentiometer up to 10 dBm, 600 ohms balanced.

Stereo-Monaural:

Switched under cover on front panel. Switches L = R for monaural. Stereo, monaural indicated by LED on front panel.

Carrier Loss:

Indicated by LED on front panel.

Phase Equalization:

Internally adjustable phase equalization is provided to compensate for phase variations in the transmitter chain.

Sample Transmitter Output:

A sample transmitter output is provided on the rear. This contains all of the modulation aspects $(L + R)_Q$, $(L + R)_I$, $(L - R)$. This is provided for diagnostics, comparison of transmitter characteristics vs. exciter characteristics.

Sample transmitter output—2 volts peak to peak into 50 ohms.

MONITOR

RF Input:

Frequency crystal controlled

Input level \div 1 volt to 10 volts

Impedance \div 50 ohms

Modulation Meters:

Meter range 0 to 133% -20 dB to + 2 dB

Attenuator range 0 to -50 dB in -10 dB steps

Accuracy at 100% modulation 400 Hz. \pm 2%

Meters switchable to + or -

LEFT or $(L + R)$

RIGHT or $(L - R)$

Peak Modulation Indicators:

$(L + R)$ Group:

-100% Indicator internally set to flash when modulation exceeds -99%

+125% Indicator internally set to flash when modulation exceeds +124%

Peak Indicator adjustable via thumb wheel switches from 30% to 150%. Modulation selectable via push button switches + or -.

$(L - R)$ Group:

Negative limit set internally to flash at 1.46 radians or 83.67°

$(L - R)$ limit set internally to flash when modulation exceeds 99%.

Peak flasher adjustable via thumb wheel switches for 30% to 125%.

Output BNC connectors on rear:

Remote Flashers $(L + R)$

$(L - R)$

Remote Meters $(L + R)$

$(L - R)$

Left Audio 600 ohm balanced & unbalanced

Right Audio 600 ohm balanced & unbalanced

$(L + R)$

$(L - R)$

25 Hz. Pilot tone

*NOTE: This is equivalent of 140% modulation, 70% envelope modulation, simultaneous with 70% stereo information.

BEST SYSTEM:

- MOTOROLA COMPATIBLE QUADRATURE
C-QUAM[®]

FULL SYSTEMS SUPPORT:

- EXCITERS
- MONITORS
- TECHNICAL SUPPORT
- RECEIVERS
- DECODER IC'S

PURCHASE PLAN TERMS:

For the monitor and exciter pair \$1500 with order, balance \$8500 on receipt of equipment.

For additional information contact:

MOTOROLA SPECIAL PRODUCTS
Dick Harasek
1216 Remington Road
Schaumburg, Illinois 60195
Phone (312) 576-3591

OR

MOTOROLA INC.
Chris Payne
Suite 200
1776 K Street, N.W.
Washington, D.C. 20006
Phone (202) 862-1549

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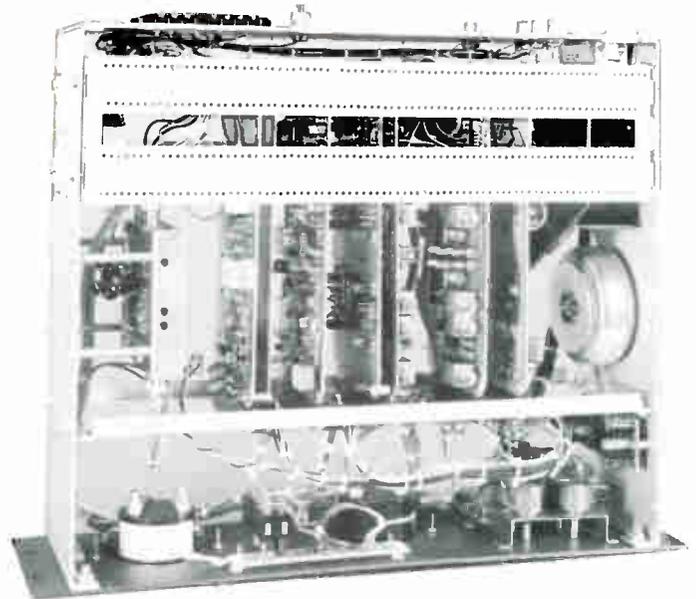
AM STEREO • GENERAL DESCRIPTION

The name "C-Quam" is derived from the phrase Compatible Quadrature Modulation. This means that the system has the advantages of quadrature modulation for stereo transmission, and is compatible with the hundreds of millions of existing monaural AM radios. In fact, the C-Quam system simply takes the sum of left and right stereo channels (L+R) and directly amplitude modulates the broadcast signal. This is the precise signal that monaural radios were designed to receive.

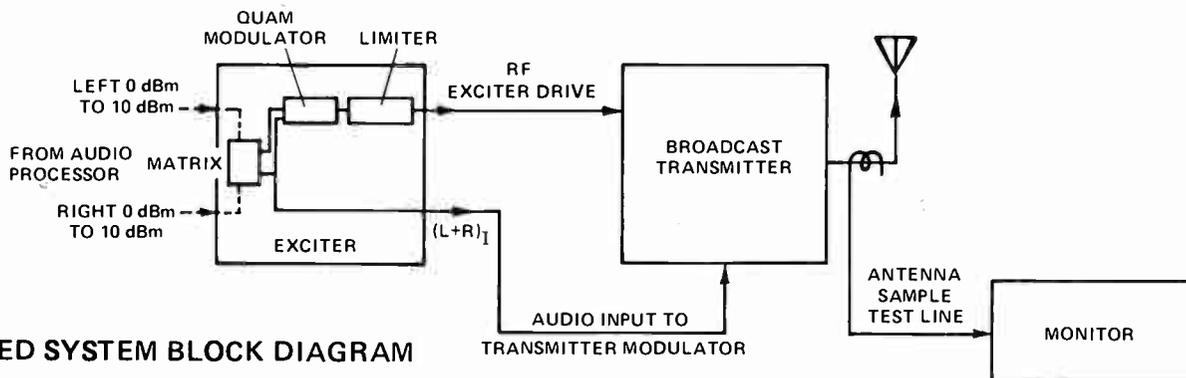
To provide stereophonic information, angle modulation results from straight forward Quadrature Modulation followed by limiting. That is, the monophonic (L+R) provides in-phase modulation while (L-R) provides quadrature phase modulation. The limiter assures constant level exciter drive to the transmitter.

A separate signal, 25Hz pilot tone, is added to the quadrature difference (L-R) signal for indicating the presence of a received stereophonic C-Quam broadcast.

Existing AM broadcast transmitters may be adapted to C-Quam with relatively simple and inexpensive modifications.



CARD CAGE CONSTRUCTION



SIMPLIFIED SYSTEM BLOCK DIAGRAM

SYSTEM SPECIFICATIONS

The following performance is typical closed loop performance of the Exciter operating into the Monitor.

Stereo Separation:

- 40 dB Minimum from 50Hz to 5kHz
- 35 dB Minimum from 20Hz to 7.5kHz
- 20 dB Minimum from 20Hz to 15kHz

Frequency Response:

L, R 20Hz - 15kHz \pm 1.5 dB

*Distortion, Harmonic:

- L=R Monaural 0.25% max. at 85% mod.
- L=-R Pure Stereo 0.5% max. at 85% mod.
- ** L,R Single Channel 1.0% max. at 75% mod.

*Actual measurements of stereo separation, frequency response and distortion are supplied with each exciter monitor pair.

** This is equivalent of 150% modulation, 75% envelope modulation, simultaneous with 75% stereo information.

MAJOR FUNCTIONS

EXCITER

RF Output: Adjustable internally up to 5 watts into 50 ohms

(L+R)_I: Adjustable under cover on front panel via 10 turn potentiometer up to +16 dBm, 600 ohms balanced.

Stereo – Monaural: Switched under cover on front panel. Switches L=R for monaural. Stereo, monaural indicated by LED on front panel.

Audio Input: Right 0 dBm to +16 dBm balanced 600 ohms. Left 0 dBm to +16 dBm balanced 600 ohms. Both inputs adjustable.

Meter Functions: (L+R)_Q (L-R)_Q Range -20 dB to +3 dB. 0 dB = 100% modulation.

Right, Left: Meter functions switched at front panel between meters.

Phase Equalization: Internally adjustable phase equalization is provided to compensate for phase variations in the transmitter chain.

Delay Circuit: Provides wide band delay for propagation path differences in transmitter.

Sample Transmitter Output: A sample transmitter output is provided on the rear. This contains all of the modulation aspects (L+R)_Q, (L+R)_I, (L-R)_Q. This is provided for diagnostics and comparison of transmitter characteristics vs. exciter characteristics.

Sample transmitter output 2 volts peak to peak into 50 ohms.

MONITOR

RF Input: Frequency crystal controlled, Input level = 1 volt to 10 volts RMS. Impedance = 50 ohms.

Modulation Meters: Meter range 0 to 140% (-20 dB to +3 dB). Attenuator range 0 to -50 dB in -10 dB steps. Accuracy at 100% modulation 400 Hz \pm 2%. Meters switchable to + or - LEFT or (L+R), RIGHT or (L-R).

Peak Modulation Indicators:

(L+R) Group: -100% Indicator internally set to flash when modulation exceeds -99%. +125% Indicator internally set to flash when modulation exceeds +124%. Peak Indicator adjustable via thumb wheel switches from 30% to

150%. Modulation selectable via push button switches + or -.

(L-R) Group: Negative limit set internally to flash at 1.46 radians or 83.67°. (L-R) limit set internally to flash when modulation exceeds 99%. Peak flasher adjustable via thumb wheel switches for 30% to 125%.

Output connectors on rear:

Remote Flashers (L+R) (L-R)

Remote Meters (L+R) (L-R)

Left Audio 600 ohms balanced and unbalanced.

Right Audio 600 ohms balanced and unbalanced.

(L+R) (L-R) 25 Hz Pilot tone

OPTIONS



Day/Night Transmitters: Provides two independent L + R outputs, two sets of equalization and individual delay adjustments for different transmitters or diverse antenna patterns.

Note: Not recommended for back-up transmitters which should have a separate exciter for complete redundant operation.

M30 Remote Meter Panel: Duplicates the modulation monitor front panel meters and peak flashers. Connected to a remote location via a direct multi conductor shielded cable.

Line Voltage Inputs: AC voltages 100, 120, 220, 240 at 50/60 Hz.

C-QUAM SUPERIORITY:

- Full coverage in monaural and stereo.
- Maximum compatibility with high quality audio processing and pre-emphasis.
- Full L+R modulation capability (from +125% to -100%) under normal programming conditions.
- Compliance with all FCC requirements.
- Maximum compatibility with existing equipment, including directional antennas.
- Superior stereo performance under adverse signal conditions.
- Minimum of falsing between mono and stereo in fringe areas and no noise bursts at the receiver end.
- Wide acceptance by both broadcasters and receiver manufacturers.

SYSTEMS SUPPORT:

- Installation
- Maintenance
- Decoder IC's
- Engineering assistance to:
 - Broadcasters
 - Generator manufacturers
 - Receiver manufacturers
- Technical service



MOTOROLA INC.

EXCITER FEATURES

- Extremely low monaural distortion typically less than 0.2% from 20 Hz to 20kHz
- Compact size 5 1/4" rack space
- Metered (L+R)_I, (L-R)_O, (L+R)_O, L, R
- Front panel adjust L+R audio, L+R balance +16 dBm output capability
- - Negative peak adjustable clipping available
- Earphone jack to evaluate audio input to exciter

MONITOR FEATURES

- Simultaneous metering of L,R or L-R, L+R
- Adjustable peak flasher from 0 to 150%
- 600Ω balanced output at 0dBm
- Separate outputs for L,R, L+R, L-R, envelope detector, and pilot
- Front panel metering of pilot tone
- Compact size 5 1/4" rack space
- Front panel metering of transmitter stereo performance
- Pilot tone indicator
- Flasher indication of modulation limits -100%, +125%, L-R limit, C-QUAM neg. limit
- Earphone jack to evaluate decoder output

TO ORDER CONTACT:

Steve Kravitz 312/576-0554 (C-Quam helper hotline)
Chris Payne 202/862-1549

-or-

MOTOROLA AM STEREO
1216 Remington Road
Schaumburg, Illinois 60195
312/576-2879

TELEX NUMBERS

TTY 28-2562
TWX 910-693-4078

-or-

910-693-4079



MOTOROLA INC.

MOTOROLA C-QUAM[®] AM STEREO -BULLETIN-

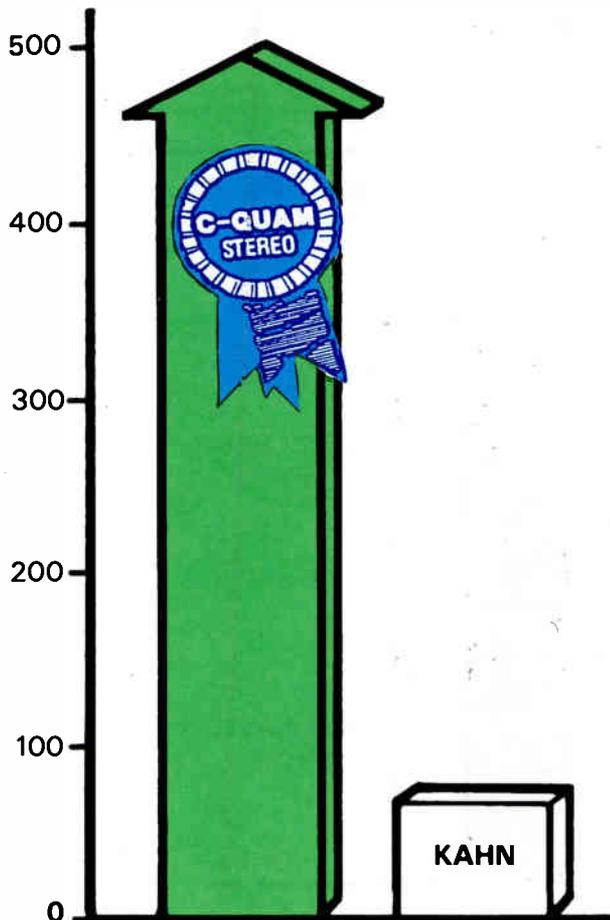
Editor: Chris Payne

Special Supplement — March, 1987

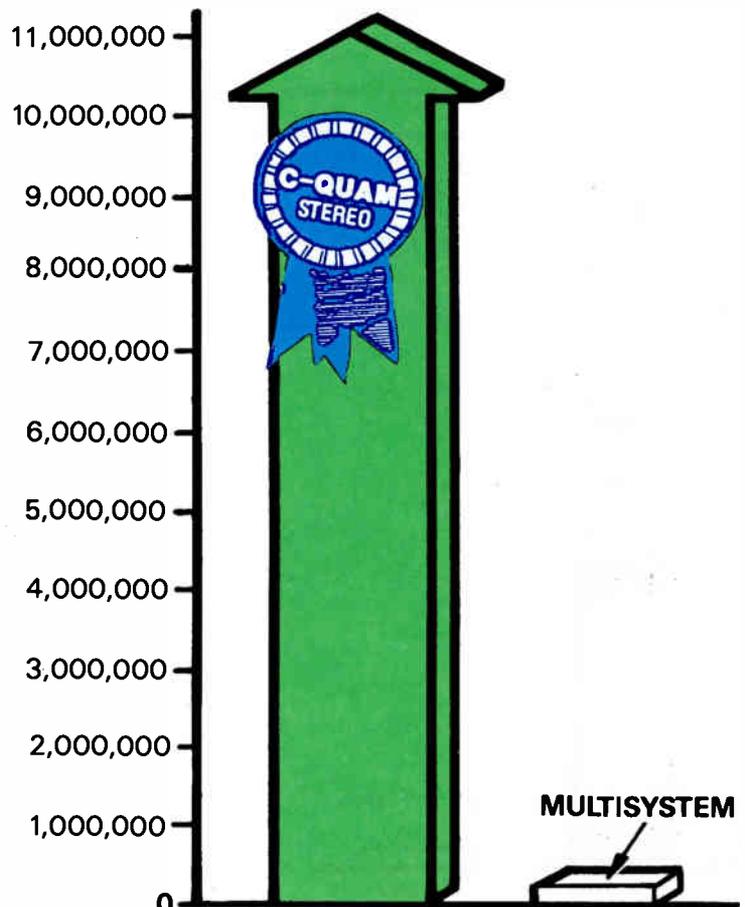
C-QUAM STEREO — THE MARKETPLACE CHOICE BY A WIDE MARGIN!

MILLIONS OF NEW CARS INCLUDE C-QUAM STEREO
RECEIVERS AS STANDARD (See Graphs)

NUMBER OF AM STEREO
STATIONS WORLDWIDE



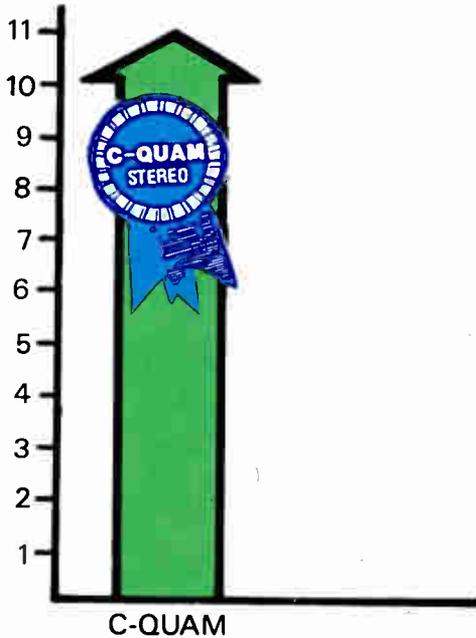
NUMBER OF AM STEREO
DECODER IC's SHIPPED TO
RECEIVER MANUFACTURERS



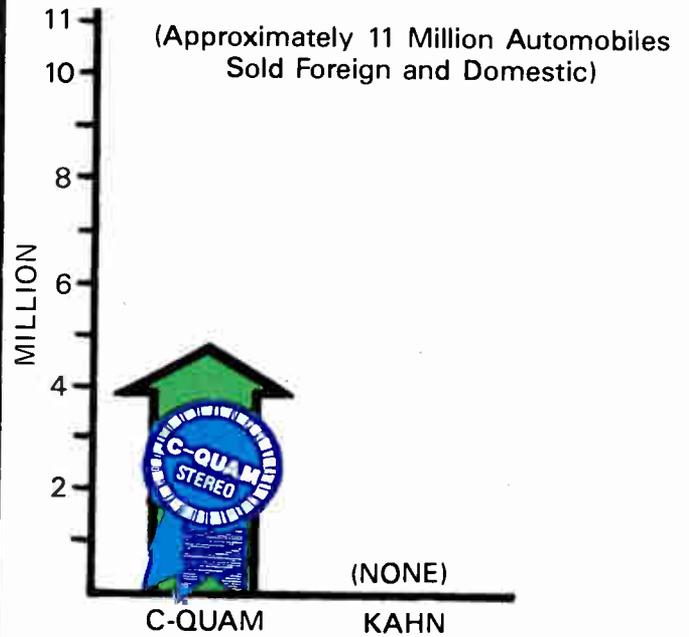
C-QUAM[®] IS A REGISTERED TRADEMARK OF MOTOROLA, INC.

IT'S C-QUAM STEREO, NO

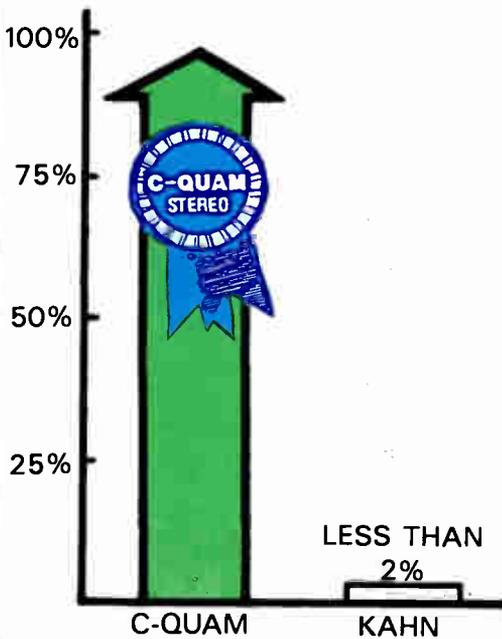
NUMBER OF COUNTRIES USING AN AM STEREO SYSTEM



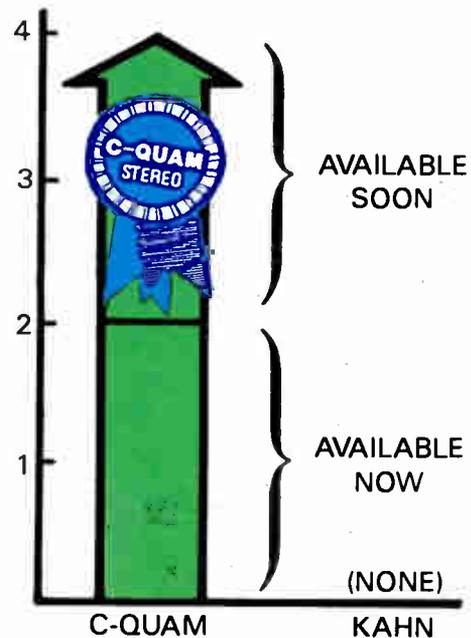
NUMBER OF 1986 AUTOMOBILES ESTIMATED WITH ORIGINAL EQUIPMENT AM STEREO RECEIVERS



PERCENTAGE OF AM STEREO RECEIVERS BUILT TO RECEIVE EACH SYSTEM IN STEREO

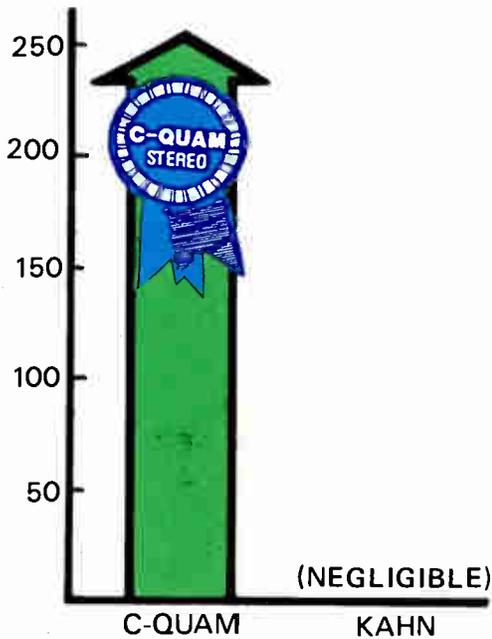


MANUFACTURERS OFFERING SINGLE SYSTEM I.C. DECODER CHIPS

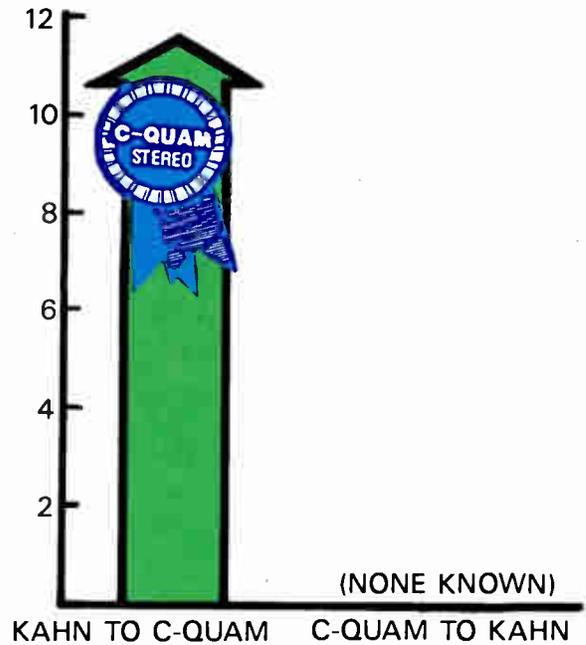


MATTER HOW IT'S MEASURED!

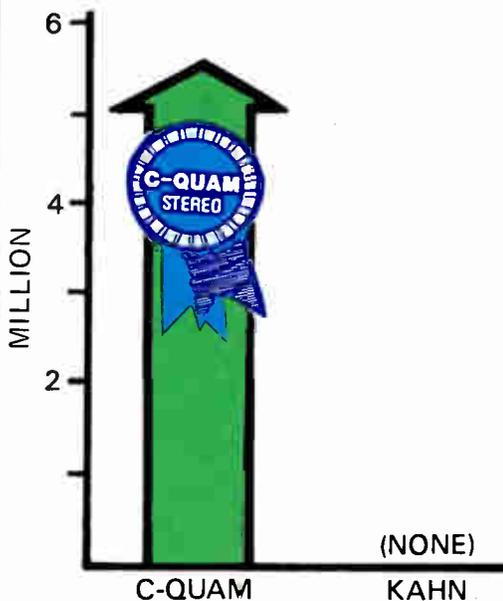
**NET GROWTH OF STEREO STATIONS
IN LAST TWO YEARS (Worldwide)**



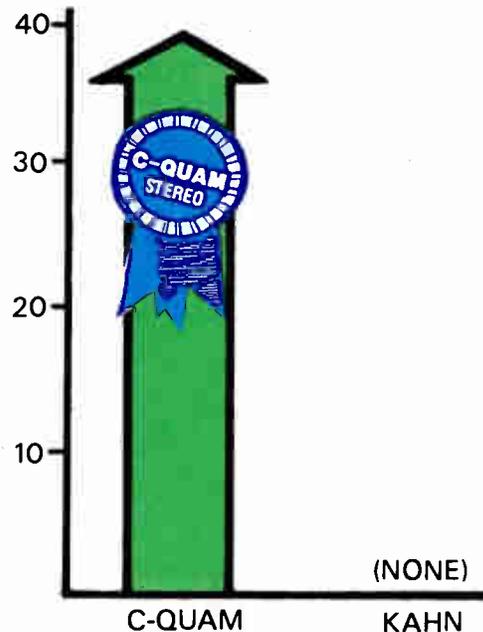
**NUMBER OF STATIONS
SWITCHING AM STEREO SYSTEMS**



**PREDICTED NUMBER OF AM STEREO
DECODER I.C.'s TO BE SHIPPED TO
ORIGINAL EQUIPMENT AUTOMOBILE
RECEIVER MANUFACTURERS IN 1987**



**NUMBER OF RECEIVER MANUFACTURERS/
BRANDS OFFERING SINGLE SYSTEM AM
STEREO RECEIVERS FOR EACH SYSTEM**



ORDER MOTOROLA MANUFACTURED C-QUAM AM STEREO TODAY

WE'LL NOT ONLY INSTALL YOUR NEW AM STEREO EQUIPMENT, WE'LL HELP YOU MARKET IT!

OUR FEATURES

TECHNICAL:

- EXPERT INSTALLATION: After hundreds of installations, we know your transmitter type.
- 100% SERVICE AND TECHNICAL SUPPORT: We'll back your system all the way as we uphold our reputation as a world leader in electronics.
- FAST DELIVERY: We'll ship and install your system to meet your schedule.

MARKETING:

- "C-QUAM HELPER HOTLINE": Direct line to our AM stereo marketing crew for instant assistance 9-5!
- PROMOTIONAL AND SALES SUPPORT: We'll provide you with the building blocks for AM stereo success; all you'll need is your station, staff and a little creativity.
- Let us keep you up to date on the latest C-QUAM AM Stereo receivers to hit your market. Millions are hitting the streets right now!

MOTOROLA C-QUAM AM STEREO ORDER FORM — NAB SPECIAL —

PRICES VALID

IN CONTINENTAL U.S.A. ONLY AND
SUBJECT TO CHANGE WITHOUT NOTICE.

FINANCING

36 and 60-month financing available. Call for details.

Check appropriate line below:

- _____ No. 1300 C-QUAM AM Stereo Exciter **\$10,500.00**
- _____ No. 1310 C-QUAM Modulation Monitor **(Installed)**
- _____ Day/Night (two transmitter operation) . . . **IF APPLICABLE**
- _____ M30 Remote Meter Panel **\$400.00**

SHOPPING SERVICE

We'll help you find the lowest prices on other equipment you may need to go stereo!

PAYMENT TERMS:

- Deposit with order **\$1,500.00**
- Balance due: Prior to shipping.

INSTALLATION INCLUDED:

Motorola approved installation includes: Analysis of transmitter (with station personnel), bring transmitter into stereo-ready form, transmitter interface installation, phase equalization, AM stereo audio measurements. Travel and living expenses included. For complete explanation, see Motorola AM Stereo Installation Work Order.

Note: Questions regarding whether a requested service is regular maintenance, to be paid for by the station or included as part of normal installation shall be conclusively resolved by Motorola.

DELIVERY: Approximately two weeks or less after deposit.

DATE _____ CALL LETTERS _____ PHONE NO. _____

NAME _____ COMPANY _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

FREQUENCY _____ TRANSMITTER _____

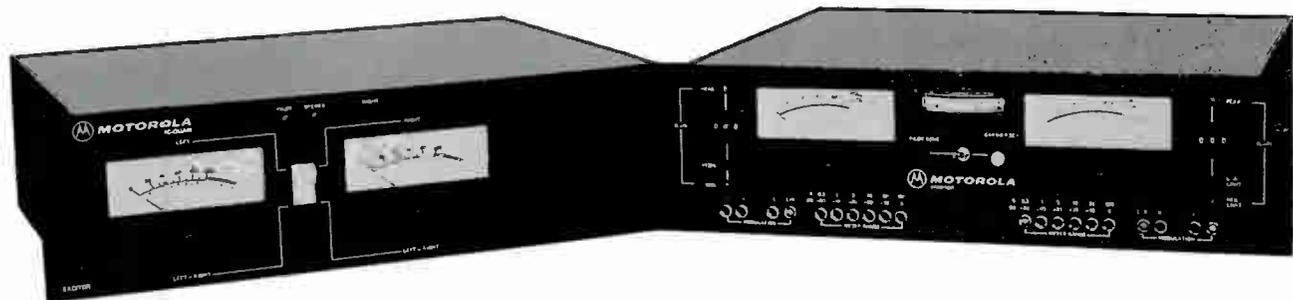
TO ORDER CONTACT:
Steve Kravitz (312) 576-0554 (COLLECT)
C-QUAM HELPER HOTLINE

TELEX NUMBERS:
TTY 28-2562
TWX 910-693-4078
-or- 910-693-4079

C-QUAM[®]
EXCITER/MONITOR

\$ 10,500.00
INSTALLED

FINANCING AVAILABLE



AM STEREO EXCITER

AM STEREO MODULATION MONITOR

TO ORDER CONTACT:

Steve Kravitz 312/576-0554 (Call Collect)

TELEX NUMBERS

TTY 28-2562

TWX 910-693-4078

— or —

910-693-4079

MOTOROLA AM STEREO
1216 Remington Road
Schaumburg, Illinois 60173

[®]
C-QUAM is a Registered Trademark of Motorola Inc.



MOTOROLA INC.

ORDER MOTOROLA MANUFACTURED C-QUAM AM STEREO TODAY

WE'LL NOT ONLY INSTALL YOUR NEW AM STEREO EQUIPMENT, WE'LL HELP YOU MARKET IT!

OUR FEATURES

TECHNICAL:

- EXPERT INSTALLATION:** After hundreds of installations, we know your transmitter type.
- 100% SERVICE AND TECHNICAL SUPPORT:** We'll back your system all the way as we uphold our reputation as a world leader in electronics.
- FAST DELIVERY:** We'll ship and install your system to meet your schedule.

MARKETING:

- "C-QUAM HELPER HOTLINE":** Direct line to our AM stereo marketing crew for instant assistance 9-5!
- PROMOTIONAL AND SALES SUPPORT:** We'll provide you with the building blocks for AM stereo success; all you'll need is your station, staff and a little creativity.
- C-QUAM RECEIVERS:** Let us keep you up to date on the latest C-QUAM AM Stereo receivers to hit your market. Millions are hitting the streets right now!

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PRICES VALID

IN CONTINENTAL U.S.A. ONLY AND
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FINANCING

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_____ No. 1310 C-QUAM Modulation Monitor **(Installed)**
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ADDRESS _____
CITY _____ STATE _____ ZIP _____
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"OVERALL, ON THE BASIS OF OUR INVESTIGATIONS, WE HAVE BEEN UNABLE TO CONCLUDE THAT MULTISYSTEM RECEIVER TECHNOLOGY OFFERS A VIABLE SOLUTION TO THE AM STEREO ISSUE."

(NTIA REPORT, AUGUST, 1987)

NTIA Says Multi-Mode Not The Answer To AM Stereo

After further study and review, the National Telecommunications and Information Administration has concluded that although multisystem AM stereo receivers may be technically feasible, the consumer electronics industry shows little interest in manufacturing them and that it is unlikely that they will ever be built in quantities large enough to affect the adoption of AM stereo.

In a report released in February of 1987, the NTIA said the growth of AM stereo was limited by the incompatibility between the two competing AM stereo systems, Kahn and Motorola C-QUAM. The NTIA proposed to make a technical study of the performance of multisystem chips and to determine the viability of multisystem reception as a solution to the assumed market stagnation.

In its latest report, issued in August of 1987, the NTIA said that although their tests show multisystem IC's to be technically feasible,

"There do appear to be significant practical obstacles to achieving a successful development of multisystem as an AM stereo solution. This conclusion is based on the apparent lack of industry interest in manufacturing multisystem receivers, the implementation delays required even if the industry were to move in the direction of multisystem technology, and finally, the continued move toward a (C-QUAM) single system environment internationally." (p.16, par 3)

The NTIA also recommended that the FCC establish a rule which would protect the C-QUAM pilot tone of 25 Hz, but did not recommend similar protection for the Kahn system because of its weaker market position. This proposed pilot tone protection is similar to that which was done by the FCC for the industry recommended TV stereo system. NTIA also said,

"We also note that while C-QUAM may not yet be the de facto standard, it is clear that it is a de facto standard in the sense that whatever the outcome of this competition, C-QUAM only or multisystem, (which would include C-QUAM), C-QUAM will be part of that standard." (p.3, par 4)

The NTIA continued,

"The advisability of a Commission decision to protect the Kahn pilot tone at this time is more problematic. While that system has won a number of adherents among broadcasters in several markets, its level of acceptance is substantially less than Motorola's. More significant, however, is the apparent lack of a significant number of AM stereo receivers in the marketplace capable of receiving a Kahn stereo signal." (p.3, par 5)

In Brazil, where C-QUAM was adopted as standard in January, 1986, NTIA Report states,

"The Brazilian MOC opted for a single system standard to avoid the market uncertainty problems observed in the United States, and to obviate the need for redundant circuitry encountered in multisystem receivers. The decision to select a standard was supported by both broadcasters and receiver manufacturers whose opinions, NTIA learned, were actively sought throughout the standard selection process. . . (p.13, par 1)

. . . The Brazilians concluded that receivers decoding the Motorola system would be significantly cheaper to manufacture than decoding the Kahn-Hazeltine system, and that receivers decoding the Motorola system allowed simpler, thus cheaper, decoder interface circuitry." (p.13, par 2)

The NTIA Report next addressed Australia, where C-QUAM is also the AM stereo standard system. NTIA found that,

". . . tests conducted by the Department of Communications (DOC) concluded that none of the multisystem receivers currently available in Australia were acceptable and that a single system receiver gave superior performance and offered appreciable advantages to the public." (p.14, par 2)

In its final overall observations section of the report, the NTIA states,

- *"First, the principal countries utilizing AM stereo have selected or appear likely to select a single AM stereo standard."*
- *"Second, the C-QUAM standard has been the single system selected in all the countries that have selected a standard. In this regard, Canada's selection of C-QUAM is the most recent and significant, but it is the third country with substantial levels of AM broadcasting to make this choice."*
- *"Third, when Brazil and Australia selected the C-QUAM system, the number of AM stereo systems in major population centers in those countries rose significantly."*
- *". . . The Brazilians selected C-QUAM as their standard and the number of Brazilian AM stereo stations grew substantially, even with the absence of any substantial numbers of AM stereo receivers." (p.15, par 1)*

In its conclusion section of the report, the NTIA states,

". . . Available data reflect C-QUAM's preeminent market position, with approximately 70% of AM stations utilizing C-QUAM and 100% of all AM stereo receivers compatible with the C-QUAM system. . . (p.17, par 3)

. . . We note Motorola's assertion that only 2-3% of AM stereo receivers currently in the market are capable of decoding the Kahn signal. Evidence to the contrary has not been presented." (p.18, par 1)

The NTIA report went on to discuss the research performed to measure the receiver industry environment. NTIA reports,

"Our further investigations have not revealed any indication that receiver manufacturers intend to move to multisystem production. To our knowledge, no manufacturers currently producing single system receivers have publicly indicated any intention to change to multisystem. Further, we have not been made aware of any additional manufacturers who have plans, however tentative, to build multisystem receivers. . . (p.9, par 4)

. . . Until such time, current trends point to further increases in the number of installed AM stereo receivers able to decode only the C-QUAM system." (p.10, par 1)

The NTIA also examined possible implementation of multisystem receivers, but stated,

"Perhaps the most significant factor leading us to the conclusion that the multisystem solution may not be viable, however, involves the significant time necessary to change over production once a decision to use multisystem technology has been made. Industry sources have indicated that it could take as much as three to four years before multisystem automobile radio receivers would become available as standard equipment, only then beginning the process of putting significant numbers of multisystem receivers into the market. . ."

The NTIA continued,

" . . . While it is conceivable that accelerated production schedules could reduce this time somewhat, even a two-year implementation period would cause serious concern. The final development and implementation of multisystem technology would therefore require a significant period, time during which the AM service could reasonably be expected to decline. This reinforces the fact that delay works against the viability of the multisystem solution." (p.10, par 2)

The NTIA report next addressed the International scene with respect to AM stereo. In Canada, where C-QUAM has been declared the official AM stereo standard, March 12, 1987 by the Department of Communications, the NTIA found that C-QUAM . . .

" . . . Met acceptable quality standards, large numbers of C-QUAM receivers are entering the listening market through the North American automobile manufacturers, and the majority of Canadian AM stereo stations use the C-QUAM system." (p.11, par 4)

In Japan where AM stereo is currently under testing, the NTIA found that . . .

" . . . The Ministry of Communications (MOC) wants a single standard and that it is unlikely to adopt a multisystem AM stereo broadcasting standard." (p.12, par 4)

The National Telecommunications and Information Administration is the Executive branch agency principally responsible for the development and presentation of domestic and international telecommunications and information policy.



MOTOROLA INC.

C-QUAM® AM STEREO



NEW MODEL 1400 EXCITER

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SPECIFICATIONS:

Audio Input: Right and left channels 0 dBm to +16 dBm. Balance levels set with input step attenuator.

Audio Output: Front panel adjustable 0 dBm to +16 dBm balanced. Additional output provided for night transmitter option. Distortion <.25% @ 80% modulation.

RF Exciter Output: Adjustable 5 to 40 VPP into 50 ohm load.

TTL Output: Fixed TTL level into 50 ohm load.

Stereo-Mono: Switched from under cover on front panel or at rear terminal block. Status indicated by front LED.

Meter Functions: $(L+R)_Q$ $(L-R)_Q$ Range -20 dB to +3 dB. 0 dB = 100% modulation.
Right, Left: Meter functions switched at front panel between meters.

Phase Equalization: Internally adjustable phase equalization is provided to compensate for phase variations in the transmitter chain.

Delay Circuit: Provides wide band delay for propagation path differences in transmitter.

Sample Transmitter Output: A sample transmitter output is provided on the rear. This contains all of the modulation aspects $(L+R)_Q$, $(L+R)_I$, $(L-R)_Q$. This is provided for diagnostics and comparison of transmitter characteristics vs. exciter characteristics.

Sample transmitter output 2 volts peak to peak into 50 ohms.

Night Card Option: Available for two transmitter operation or diverse antenna patterns.

Headphone Jack: Front panel output for evaluating audio drive to exciter.

9 kHz Channel Spacing: Optional for international operation.

Line Voltage Input: 100, 120, 220, 240 VAC @ 50/60 Hz. Selectable on rear power module.

NEW FEATURES:

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Easy removal/insertion of cards, with all controls accessible from front or top!
- **Front Handles:**
Easy in ... out ... carry!
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- **Motherboard:**
Eliminates complex wiring harnesses!
- **Remote Stereo/Mono Switching:**
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- **LED Power Supply Status Indicators:**
Supply voltage status at a glance!

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L or R @ 75% Mod.	<.75% @ 1kHz <1% @ Full Bandwidth
L + R @ 90% Mod.	<.25% @ Full Bandwidth
L-R @ 90% Mod.	<.5% @ 1kHz <1.5% @ Full Bandwidth

Separation @ 1 kHz

L + R → L-R	>45 dB
L-R - L + R	>50 dB
L → R or R → L	>45 dB @ 1kHz >35 dB @ 10 kHz

MOTOROLA AM STEREO
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American Audio	ET-8602	Automobile
Audi		Automobile
Audiovox	CPDGO GMADGO	Chrysler Equivalent GM/Delco Equivalent
Becker		Automobile
Blaupunkt	Dallas SQN88, Tucson SQRO6, Berlin TOR07	Automobile
Brentwood	CR70, CR75	Automobile
Carver	2000 Professional Series TX11A	Home Receiver Digital Tuner
Clarion	990E, 8900RT, 8925RT, 9425RT AUDIA Series 200, 200E	Automobile
Concord	HPL-550	Automobile
Eurovox	MCC2301R, MCC2330R	Automobile (Australia)
Ford/Lincoln/Mercury	E5VY - 18806B, C, E E5TZ - 18806B, C, E E5ZZ - 18806B, C, E	Dealer Option
Chrysler/Plymouth/Dodge	4311687, 4311686 (RAN) 4311102, 431103 (RAY) 4311827, 4311828 (RAL)	AM Stereo automatically included in all new domestically built Chrysler Corp. vehicles having FM stereo
GM/Delco	UX-1, UT-4, YE-2	Available as factory or dealer in- stalled option on most GM cars and trucks. Standard on some models.
Grundig	UC-436	Automobile
Kenwood	KRC-8001	Automobile
Kraco	ETR-1090, ETR-1084	Automobile
Majestic	MCR 84900	Automobile
Marantz	SR-440, SR-640, SR-840, SR-940	Home Receivers
Mazda	Standard in RX7	Automobile
Mercedes	Grand Prix	Automobile
Mitsubishi	JX3, MX4 DAR56	Automobile Home Receiver
Nissan	Maxima	Standard
Omnivox	CR620	Automobile
Peconic		Automobile
Pioneer		Australia
Potomac	SMR-11	Broadcast Monitor
Radio Shack	TM-152 (31-1967) 12-1923	Home Tuner Automobile
Rolls Royce		Automobile
Saab	Standard in 900 Turbo SR	Options in others
Sansui		Australia
Sharp	RG-B914 (Bk)	Automobile
Sherwood	CRD-180, CRD-210, CRD-350	Automobile
Soundtech	ST850	Automobile
Sparkomatic	SR-420, SR-425, SR-430	Automobile
Sunkyong	SIR-7900, SIR-8100	Automobile
Toyota	5625 (MR2), 5627 (Cressida) 1626 (Supra/Cellica GTS)	Standard Also available on other vehicles
Volkswagen	SC-99 ETR, SC-73 ETR	For Golf and GTI
Volvo		Automobile

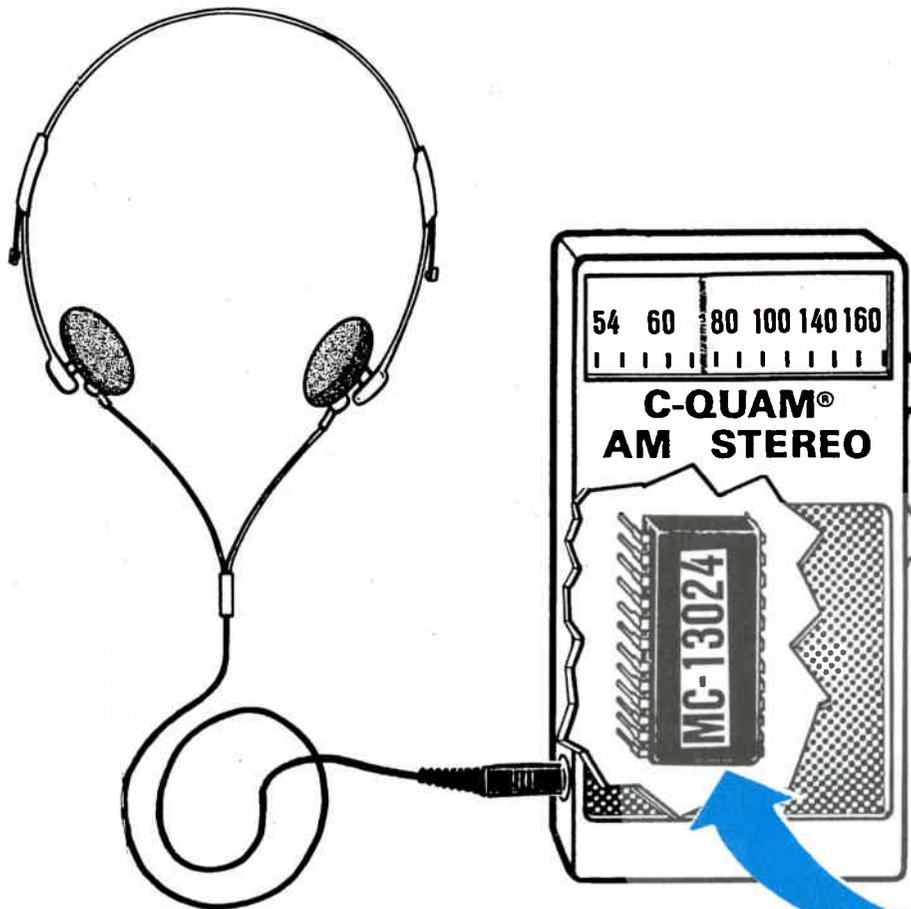


MOTOROLA INC.

MOTOROLA C-QUAM® AM STEREO — BULLETIN —

Editor: Chris Payne

Issue 3, 1987



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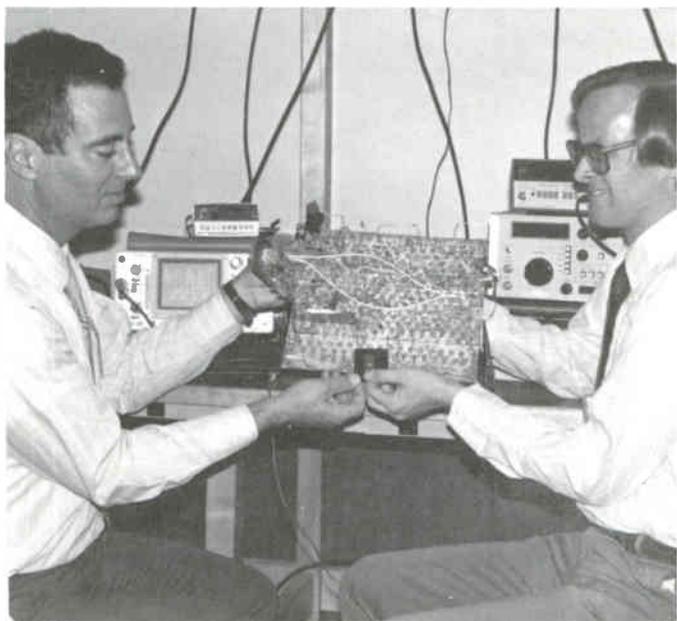
**MC-13024
IC INSIDE!**

THE MC-13024 PERSONAL PORTABLE C-QUAM IC IS ON TARGET

In late September, it was confirmed that a new integrated circuit was born at Motorola's semiconductor facility in Phoenix, Arizona. The new MC-13024 is destined to play a major role in expanding the consumer awareness of AM stereo. The reason is that this IC can be used by radio manufacturers to produce a very promotable personal portable ("Walkman" type) C-QUAM AM stereo radio. Amazingly, this new IC provides most all of the essential active circuitry needed to provide a complete personal portable AM stereo radio!!

The IC will operate on two small batteries and is designed for very low current consumption, as low as 5 mA. It incorporates all the functions of an AM stereo tuner including RF, IF, C-QUAM AM stereo decoding, an audio matrix and the provision to accommodate NRSC de-emphasis. It is expected to be easy for the designer to create a product from the IC because it only needs an antenna, an audio amplifier, some resistors, capacitors, coils, battery and headphones and...voila!...*C-QUAM AM stereo!* Motorola expects multi-millions of these radios to be produced in many countries of the world. This translates into many types of receivers, a wide availability, and at a low cost.

Motorola design engineers, Chuck Marik and Larry Ecklund spent years designing and developing the breadboard of this revolutionary new IC. Reducing the breadboard to an actual integrated circuit also required the assistance of many engineers at Motorola's semiconductor sector.



Motorola Design Engineers, Chuck Marik (left) and Larry Ecklund, hold an engineering breadboard and the actual die of a MC-13024 integrated circuit.

After the first samples of the actual integrated circuit became available, a C-QUAM receiver was constructed and tested at the Motorola modulation laboratory located on the campus of Motorola's headquarters in Schaumburg, Illinois. High quality AM stereo was heard loud and clear on the C-QUAM stations in the Chicago area.

Exhaustive laboratory testing of the IC is being conducted worldwide. Based on the preliminary testing however, it looks like receiver manufacturers can expect delivery of the first samples together with applications notes and receiver design recommendations by the end of 1987.

Highly promotable, battery-operated portable C-QUAM AM stereo receivers have been requested by many broadcasters as one way to effectively improve consumer awareness of AM stereo. These receivers will provide an opportunity to introduce the younger audience to the new AM radio, with high quality *AM stereo!* Just like any other currently popular personal portable product, these C-QUAM units will be used while jogging, at the beach, while riding a bike or virtually anywhere that AM radio can be received. It fits today's lifestyles.

Not only does a personal portable C-QUAM AM stereo receiver fit the on-the-move lifestyle of people in the U.S., but it also fits an extremely large market in underdeveloped countries. In many lesser developed and highly populated countries of the world, AM radio continues to be the most widely used method of mass communications. Today, hundreds of millions of people rely on the wide coverage provided by high powered medium frequency (AM) radio. Most of these people do not own automobiles and get their information via battery operated radios. Because it may be many years before FM broadcasting will reach these people, the most cost effective means of updating the broadcasting service in these countries is to install stereo on the present AM stations. With the near future availability of a variety of portable C-QUAM AM stereo receivers, all can economically enjoy the advantages of stereo reception.

C-QUAM AM STEREO PROMOTIONAL RADIOS

Broadcasters may be interested in the availability of the new portable C-QUAM AM stereo receivers which are expected to be manufactured using the new MC-13024 IC. Motorola personnel will be communicating with a number of receiver manufacturers in the Far East to promote the use of the new IC's and to assist engineers with incorporating them in their designs. It is planned to discuss the manufacturing of personal portable receivers with many companies in Japan, Taiwan, Korea and Hong Kong.

Your station might be interested in encouraging the marketing of portable C-QUAM AM stereo receivers. If you desire, write us a letter on your letterhead expressing your interest. We will be happy to convey this information to the appropriate receiver manufacturers. Write your letter to: Chris Payne, Motorola Inc., Suite 300, 1776 K Street, N.W., Washington D.C. 20006.

MORE KAHN AM STEREO STATIONS CHANGE TO C-QUAM STEREO

Congratulations to KMPC, Los Angeles, WQXI in Atlanta and KMBZ in Kansas City, Kansas for conversion from the Kahn system to beautiful C-QUAM stereo. Now these stations can enjoy total monophonic compatibility and coverage while also having AM stereo that is fully compatible with the millions of C-QUAM AM stereo receivers. Again congratulations, and light those stereo lights!

NTIA SAYS MULTI-MODE NOT THE ANSWER TO AM STEREO

"Overall, on the basis of our investigations, we have been unable to conclude that multi-system receiver technology offers a viable solution to the AM stereo issue."

(NTIA Report - August, 1987)

After further study and review, the National Telecommunications and Information Administration, has concluded that although multi-system AM stereo receivers appear to be technically feasible, the consumer electronics industry shows so little interest in manufacturing them, that it is unlikely that they will ever be built in quantities large enough to affect the adoption of AM stereo.

In the latest report, issued in August of 1987, the NTIA said that although their tests show the multi-system IC to be technically acceptable, "there do appear to be significant practical obstacles to achieving a successful development of multi-system AM stereo solution. This conclusion is based on the apparent lack of industry interest in manufacturing multi-system receivers, the implementation delays required even if the industry were to move in the direction of multi-system technology, and finally, the continued move toward a (C-QUAM) single system environment internationally." NTIA also recommended that the FCC establish a rule which would protect the C-QUAM pilot tone frequency of 25 Hz but did not recommend similar protection for any other system. This proposed pilot tone protection is similar to that which was done by the FCC for the industry recommended TV stereo system.

The NTIA report documents the dominant market-place position of the C-QUAM AM stereo system in the broadcasting and consumer electronics industries, nationally and internationally. NTIA also found that the predictions for a multi-system future for AM stereo are not supported by the future plans by receiver manufacturers.

If broadcasters had any doubts about the existence of a de-facto standard AM stereo broadcast system, the NTIA findings should have finally, and with certainty, answered that question . . . it's the Motorola C-QUAM system.

A SYNOPSIS OF NTIA COMMENTS ON THE INTERNATIONAL SCENE

- Australia: specified C-QUAM system because multi-system receivers were technically inferior to single system. Now 88% of Australian population is aware of AM stereo and 20% are likely to buy an AM stereo receiver in 1987.
- Brazil: selected C-QUAM system because receivers would be less expensive.
- Canada: chose C-QUAM system because a single standard would accelerate growth of AM stereo. Most receivers are for C-QUAM system, and public confusion would be less.
- Japan: is currently making AM stereo tests, but their Ministry of Communications told NTIA that Japan will select a single system.
- Many other countries of the world appear to be interested in a single standard for AM stereo. Because no country has yet adopted a multi-system standard, and all countries with a standard have selected the C-QUAM system and no other, this may also affect the future demand (or lack of) for multi-system receivers.

NTIA'S TECHNICAL TESTS

The findings of NTIA that there is essentially no manufacturer interest in producing multi-system receivers has been known by the marketplace for several years. The independent NTIA observations should convince any supporters of multi-system in the U.S. broadcasting community that there will be no multi-system receiver "solution" to multi-system broadcasts.

NTIA also reported that the results of their testing of single and multi-system decoders and receivers indicated there was no significant technical difference between the two. Motorola notes that this finding is completely at odds with the testing performed by Motorola and many receiver manufacturers where *significant* technical quality performance differences were consistently found. In point of fact, Motorola design engineers know of no way that multi-system decoders can perform competitively.

Motorola has worked very hard to produce an AM stereo system which is as technically competitive with FM stereo as is possible. This includes the fundamental design of the C-QUAM system itself,

and the design and implementation of the decoder IC's. For instance, the recently introduced AM stereo decoder IC, the MC-13022 typically has mono and stereo distortion levels less than 0.4% and separations in the mid-thirties at modulation levels typically used in AM broadcasting. *Motorola has been unable to measure this type of performance in any multi-system IC decoder introduced to date.*

In any event, the results of the NTIA multi-system IC testing and evaluation are not relevant because, as NTIA found out, there is a resounding lack of interest by receiver manufacturers in building multi-system receivers. The statistics have reflected this for several years and the NTIA research simply provides an independent confirmation of what has been well known...the world wants a single technical standard for AM stereo and receiver manufacturers are indicating their preference by building only single system C-QUAM receivers. Motorola is of the conviction that the single system decoder is the correct evolutionary path to optimum performance and economics.

NTIA COMMENTS ON MULTI-SYSTEM ECONOMICS

The NTIA report indicated that no evidence was presented showing economic penalties for multi-system decoding. Motorola wishes to note that it possesses considerable information illustrating the very significant cost and complexity penalty incurred by the multi-system decoding which has been offered to date.

NTIA COMMENTS ON PILOT TONE PROTECTION

One of the recommendations of NTIA is for the FCC to protect the pilot tone frequency of only the C-QUAM system. The reasoning is that the C-QUAM system has achieved a sufficiently high marketplace acceptance that the 25 Hz pilot tone frequency should now be reserved for exclusive use as the identifier for a C-QUAM transmission. NTIA did not recommend a similar protection for any other system noting that there are only a negligible number of receivers which can receive other systems in stereo, and less than 30 % of the AM stereo stations still use other systems.

Pilot tone protection has been used by the FCC for protection of the industry recommended BTSC TV stereo system. The FCC exclusive protection of the BTSC TV stereo system is believed to have significantly assisted in the industry commitment to one TV stereo standard and has contributed to the fast growth and acceptance of TV stereo.

Motorola believes that an FCC proceeding looking toward an AM stereo standard may prove to be lengthy and controversial, but a simple rule protecting the C-QUAM pilot tone, as is the case with TV stereo, may be a fast and effective way to help accelerate the growth of AM stereo and the revitalization of AM radio.

FORD'S ABOARD!

After several years of limited application of C-QUAM AM stereo radios, Ford is greatly expanding the availability of C-QUAM AM stereo in its new 1988 model year automobiles. Beginning in October, 1987, the C-QUAM stereo feature, with a wider AM bandwidth and an overall improved AM section will be offered in three upgrade Hi-Audio radios including the Ford-JBL line of premium sound systems. C-QUAM AM stereo will be offered as standard equipment on the Mark series, the Lincoln Continental and town cars. The C-QUAM receivers may also be ordered as factory installed option for a number of other cars in the Ford line. Dealer installation option will still be available.

The expanded Ford commitment to AM stereo now has all of the big three U.S. automobile manufacturers marketing automobiles with substantial quantities of C-QUAM AM stereo receivers. The 1988 model year volume from *only* the U.S. big three is expected to exceed 2,700,000 C-QUAM radios. The total volume from all sources for the same period is expected to bring the total estimated C-QUAM AM stereo receiver population to approximately 17,000,000!

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