

YAMAHA

SYSTEM CONTROLLER

PROCESSEUR DE CONTROLE DE SYSTEME

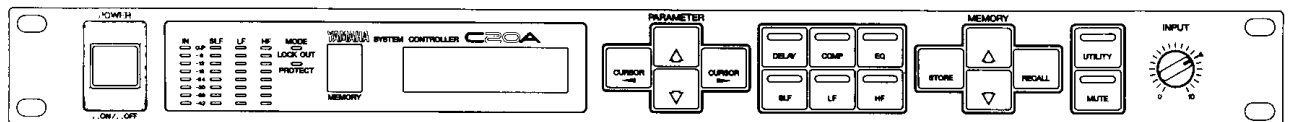
SYSTEMSTEUERPROZESSOR

C20A

OPERATION MANUAL

MANUEL D'INSTRUCTIONS

BEDIENUNGSANLEITUNG



FCC INFORMATION (U.S.A.)

1. IMPORTANT NOTICE: DO NOT MODIFY THIS UNIT!

This product, when installed as indicated in the instructions contained in this manual, meets FCC requirements. Modifications not expressly approved by Yamaha may void your authority, granted by the FCC, to use the product.

2. IMPORTANT: When connecting this product to accessories and/or another product use only high quality shielded cables. Cable/s supplied with this product MUST be used. Follow all installation instructions. Failure to follow instructions could void your FCC authorization to use this product in the USA.

3. NOTE: This product has been tested and found to comply with the requirements listed in FCC Regulations, Part 15 for Class "B" digital devices. Compliance with these requirements provides a reasonable level of assurance that your use of this product in a residential environment will not result in harmful interference with other electronic devices. This equipment generates/uses radio frequencies and, if not installed and used according to the instructions found in the users manual, may cause interference harmful to the operation of other electronic devices. Compliance with FCC regulations does not guarantee that interference will not occur in all installations. If this product is found to be the source of interference, which can be determined by turning the unit "OFF" and "ON", please try to eliminate the problem by using one of the following measures:

Relocate either this product or the device that is being affected by the interference

Utilize power outlets that are on different branch (circuit breaker or fuse) circuits or install AC line filter/s.

In the case of radio or TV interference, relocate/reorient the antenna. If the antenna lead-in is 300 ohm ribbon lead, change the lead-in to co-axial type cable.

If these corrective measures do not produce satisfactory results, please contact the local retailer authorized to distribute this type of product. If you can not locate the appropriate retailer, please contact Yamaha Corporation of America, Electronic Service Division, 6600 Orangethorpe Ave, Buena Park, CA 90620

*This applies only to products distributed by YAMAHA CORPORATION OF AMERICA

CANADA

THIS DIGITAL APPARATUS DOES NOT EXCEED THE "CLASS B" LIMITS FOR RADIO NOISE EMISSIONS FROM DIGITAL APPARATUS SET OUT IN THE RADIO INTERFERENCE REGULATION OF THE CANADIAN DEPARTMENT OF COMMUNICATIONS.

LE PRESENT APPAREIL NUMERIQUE N'EMET PAS DE BRUITS RADIOELECTRIQUES DEPASSANT LES LIMITES APPLICABLES AUX APPAREILS NUMERIQUES DE LA "CLASSE B" PRESCRITES DANS LE REGLEMENT SUR LE BROUILLAGE RADIOELECTRIQUE EDICTE PAR LE MINISTERE DES COMMUNICATIONS DU CANADA.

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Litiumbatteri!

Bör endast bytas av servicepersonal.
Explosionsfara vid felaktig hantering.

VAROITUS!

Lithiumparisto, Räjähdyksvaara.
Pariston saa vaihtaa ainoastaan aian ammattimies.

ADVARSEL!

Lithiumbatteri!
Ekspløsningsfare. Udskiftning må kun foretages af en sagkyndig, – og som beskrevet i servicemanualen.

IMPORTANT NOTICE FOR THE UNITED KINGDOM

Connecting the Plug and Cord

WARNING: THIS APPARATUS MUST BE EARTHED

IMPORTANT: The wires in this mains lead are coloured in accordance with the following code:

GREEN-AND-YELLOW : EARTH
BLUE : NEUTRAL
BROWN : LIVE

As the colours of the wires in the mains lead of this apparatus may not correspond with the coloured markings identifying the terminals in your plug, proceed as follows:

The wire which is coloured GREEN-AND-YELLOW must be connected to the terminal in the plug which is marked by the letter E or by the safety earth symbol or coloured GREEN or GREEN-AND-YELLOW.

The wire which is coloured BLUE must be connected to the terminal which is marked with the letter N or coloured BLACK.

The wire which is coloured BROWN must be connected to the terminal which is marked with the letter L or coloured RED.

Preface

The C20A is an extremely versatile sound-reinforcement speaker system controller which gives the operator broad control over crossover, equalization, and delay parameters right at the console location. Crossover capabilities include 1-in/3-out operation (HF, LF and SLF) so a subwoofer can be added when needed, a choice of crossover slopes (6, 12, 18 or 24 dB/oct, symmetrical or asymmetrical) and precisely programmable crossover frequencies. Equalization parameters allow compensation for room acoustics, suppression of bass buildup in stacked systems and distance compensation. Delay times can be precisely set from 0 milliseconds up to 1.3 seconds for time alignment or to compensate for system offset delays. The C20A also features LF and HF compressors with programmable threshold compression ratio and attack and release times.

The C20A comes with preset programs designed to provide optimum performance with the Yamaha S1520S, S1525S Speaker System, SM1525 Foldback Speaker System, SW1820S Subwoofer and Y20, Y25, Y30 Active Servo Processor. 15 user memory locations are provided so that custom programs can be created and stored for recall whenever needed. For maximum system security a number of access modes are provided—variable (complete access to all parameters), protect (limited access) and Lockout (no access). Further versatility is provided by a MIDI interface that allows remote program selection and program up/down loading. There's also a MIDI Link function that allows 2 C20A units to be programmed simultaneously when connected via a MIDI cable.

Superior sound quality is guaranteed by the most advanced digital signal processing circuitry available. Proprietary 18-bit Delta-Sigma conversion technology provides a dramatic improvement in dynamic range and significantly enhances low-level signal performance over the more common PCM conversion method. The proof is in the performance: dynamic range over 100 dB, THD less than 0.03% and a full 20 kHz bandwidth.

SERVICE

This product is supported by YAMAHA's worldwide network of factory trained and qualified dealer service personnel. In the event of a problem, contact your nearest YAMAHA dealer.

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PRECAUTIONS !! PLEASE READ THIS BEFORE PROCEEDING !!

1. Avoid Excessive Heat, Humidity, Dust and Vibration

Keep the unit away from locations where it is likely to be exposed to high temperatures or humidity — such as near radiators, stoves, etc. Also avoid locations which are subject to excessive dust accumulation or vibration which could cause mechanical damage.

If the C20A is to be rack mounted, make sure that sufficient ventilation is provided.

2. Avoid Physical Shocks

Strong physical shocks to the unit can cause damage. Handle it with care.

3. Do Not Open The Case Or Attempt Repairs Or Modifications Yourself.

This product contains no user-serviceable parts. Refer all maintenance to qualified Yamaha service personnel. Opening the case and/or tampering with the internal circuitry will void the warranty.

4. Make Sure Power Is Off Before Making Or Removing Connections.

Always turn the power OFF prior to connecting or disconnecting cables.

5. Handle Cables Carefully

Always plug and unplug cables — including the AC cord — by gripping the connector, not the cord.

6. Clean With a Soft Dry Cloth

Never use solvents such as benzine or thinner to clean the unit. Wipe clean with a soft, dry cloth.

7. Always Use the Correct Power Supply

The power requirements for the C20A are clearly marked on the rear panel. Make sure the specified mains voltage matches the voltage in your area before using the unit!

8. Electrical Interference

Since the C20A contains digital circuitry, it may cause interference and noise if placed too close to TV sets, radios or similar equipment. If such a problem does occur, move the C20A further away from the affected equipment.

9. Memory Backup

The C20A contains a special long-life battery that retains the contents of its internal RAM memory even when the power is turned OFF. The backup battery should last for approximately 5 years. When the battery voltage drops to a level that is too low to maintain the memory contents, the following message will appear on the C20A display when the power is turned ON:



If this display appears, have the backup battery replaced by qualified Yamaha service personnel.

DO NOT ATTEMPT TO REPLACE THE BACKUP BATTERY YOURSELF!

10. Error Messages

When the C20A is initially turned ON an internal diagnostic program is run automatically to check over-all operation. If an error is encountered, one of the following error messages will appear on the MEMORY display:

E0.....ROM checksum error.

E1.....CPU RAM read/write error.

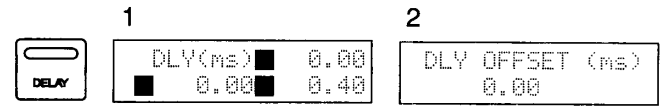
E2.....Peripheral RAM read/write error.

If an error message appears, have the C20A checked by qualified Yamaha service personnel and be sure to tell the service staff which error appeared.

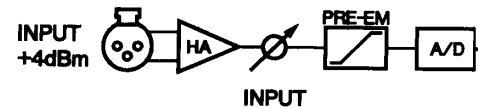
QUICK FUNCTION GUIDE

In order to optimize the performance of any sound reinforcement speaker system, the C20A offers the functions listed on this page. The keys used to access each function and the corresponding displays are also shown. Refer to the page numbers given for full details:

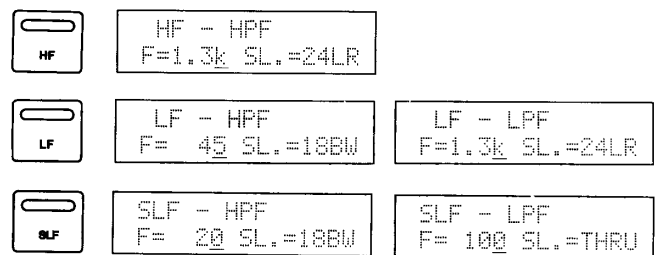
● Digital Delay (0 — 1300 ms) → Page 10.



1. Independent delays for the HF, LF and SLF channels allow precise speaker time alignment.
 2. An overall system offset delay allows compensation for distance-related delays between the main and auxiliary speakers.
- * Delay values can be displayed in milliseconds, meters or feet.



● Dividing Filter → Page 12.



F: Cutoff frequency
SL: Slope

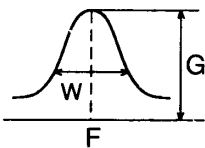
● Parametric Equalizer → Page 13.



HF-PEQ Q= 5.0
F= 18k G=+12



LF-PEQ Q=0.20
F= 200 G= -2



Q: Q factor (F/W)
F: Center frequency
G: Gain

● Compressor/limiter → Page 15.



HF COMP.
TH=+14 RA= 20:1

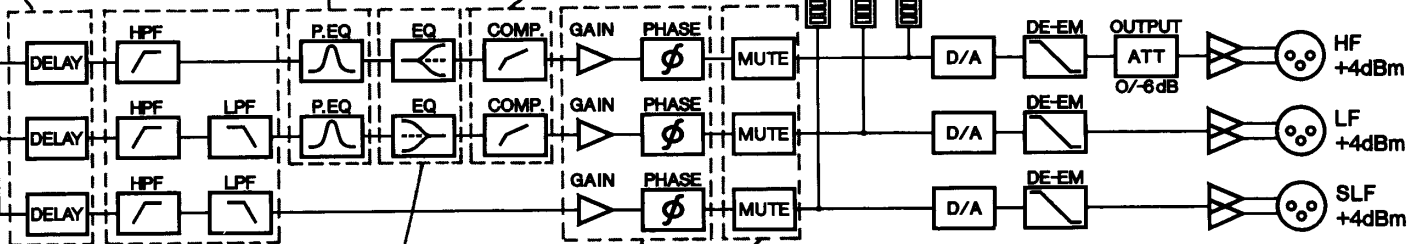
HF COMP.
AT=3.2 RE=.30

LF COMP.
TH= +8 RA=1.4:1

LF COMP.
AT= 10 RE=.50

TH: Threshold level
RA: Ratio
AT: Attack time
RE: Release time

THE CLIP INDICATORS TURN ON WHEN OUTPUT LEVEL REACHES +18dBm.



● Compensation Equalizer → Page 14.



1 STACKING
1 BOX

2 DISTANCE
SHORT THROW

3 ROOM COND.
LIVE

1. STACKING: Compensates for low-frequency aberrations in stacked speaker systems.
2. DISTANCE: Compensates for distance-related high-frequency loss.
3. ROOM COND.: Compensates for dead or live room conditions.

● Mute Setting → Page 16.



1 CH-MUTE OFF
 OFF OFF

2 MUTE(ALL)
OFF

1. CH-MUTE: Individual channel muting.
2. MUTE (ALL): All-channel mute.

● Output Level & Phase → Page 12.



HF GAIN=-5.5dB
PHASE=NOR



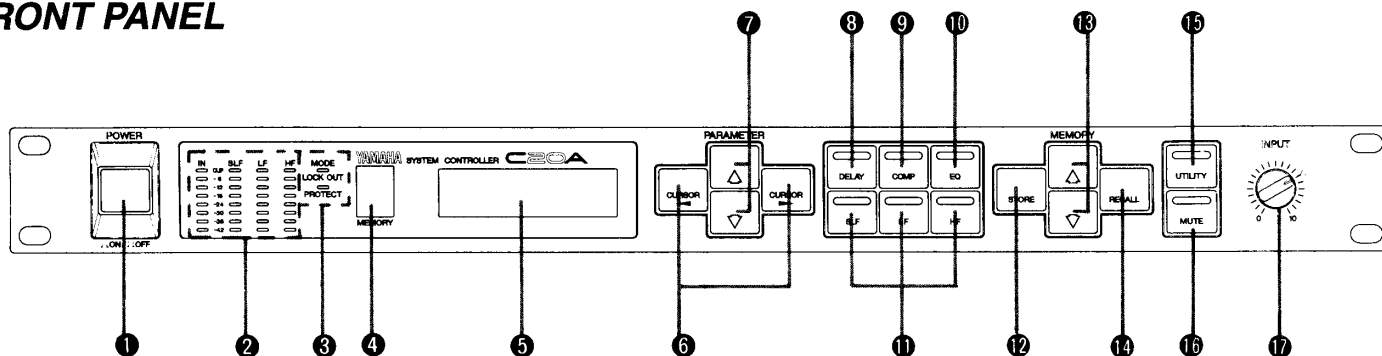
LF GAIN= 0.0dB
PHASE=NOR



SLF GAIN= 0.0dB
PHASE=NOR

CONTROLS & CONNECTORS

FRONT PANEL



1 POWER Switch

Press to turn the power ON or OFF. The output of the C20A is muted for several seconds after the power switch is turned ON to prevent possible damage to power amplifiers and speakers due to the power-on voltage surge.

The program selected at the time the power was previously turned OFF will be automatically recalled with the power is turned ON.

2 Input & Output Level Indicators

These 8-element LED level meters provide accurate peak-level readings for the input signal and the output signals at each of the C20A's three outputs—SLF (super low frequency), LF (low frequency), and HF (high frequency). The lower 7 segments correspond to -42, -36, -30, -24, -18, -12 and -6 dB. The highest segment is a CLIP indicator that warns of circuit overload.

[Details on page 9]

3 MODE Indicators

Indicate whether the C20A is in the "LOCK OUT" or "PROTECT" access mode. The access modes are described in "2. MODE Switch" on the following page.

4 MEMORY Display

This 7-segment LED display shows which of the C20A's 15 available memory locations is selected —1 through F (hexadecimal: 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F).

[Details on page 9]

5 LCD Display

Two 16-character display lines show program names, parameters and values for easy operation and programming. The display is backlit for optimum visibility.

6 [CURSOR] [CURSOR] Keys

The [←] and [→] keys move the cursor left or right to the desired parameter within the LCD display screen for editing.

[Details on page 10]

7 PARAMETER Keys

The PARAMETER [↗] and [↘] keys adjust the value of the selected parameter.

[Details on page 10]

8 [DELAY] Key

Accesses the individual delay parameters for the SLF, LF and HF channels, as well as an overall delay offset parameter.

[Details on page 10]

9 [COMP] Key

Accesses the compressor/limiter functions for the LF and HF channels.

[Details on page 15]

10 [EQ] Key

Accesses the STACKING, DISTANCE, and ROOM CONDITIONS compensation EQ for the LF and HF channels.

[Details on page 14]

11 [SLF], [LF], [HF] Keys

These keys access the dividing filter gain, and phase parameters for the SLF, LF, and HF channels.

[Details on page 12]

12 [STORE] Key

The [STORE] key is used to store newly edited program data to one of the C20A's memory locations.



[Details on page 16]

13 MEMORY [] and [] Keys

These keys are used to select a desired program number (1 through F) prior to recalling the selected program or storing new data into the selected memory location.

[Details on page 9]

14 [RECALL] Key

This key recalls a program selected by using the MEMORY [] and [] keys.

[Details on page 9]

15 [UTILITY] Key

The [UTILITY] key accesses a range of utility functions including program title edit, delay display mode (milliseconds, feet or meters), MIDI controller assignments, MIDI channel selection, and bulk dump operations.

[Details on page 17]

16 [MUTE] Key

Accesses the individual mute functions for each channel as well as the all-channel mute function.

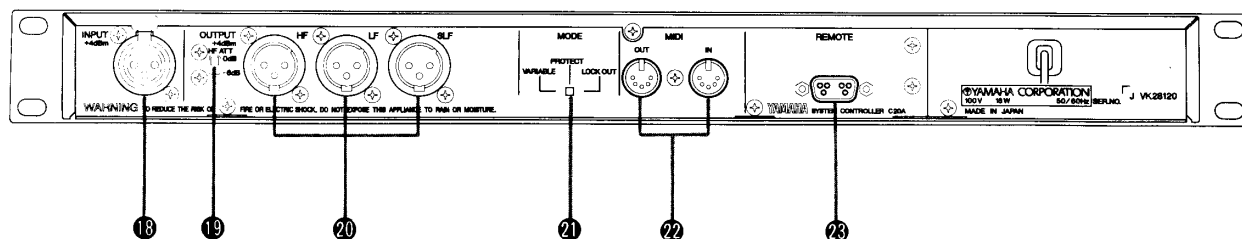
[Details on page 16]

17 INPUT Level Control

Matches the sensitivity of the C20A input to the source signal. Use in conjunction with the "IN" level indicator to set up the optimum input level for various signals.

[Details on page 9]

REAR PANEL



18 INPUT Connector

Electronically balanced main input to the C20A. Nominal input level/impedance is +4 dB/10 k Ω . The pin connections are:

- Pin 1..... GROUND
- Pin 2..... HOT
- Pin 3..... COLD

19 HF ATT Switch

This switch can be set to the "+6dB" position to attenuate the level of the HF output by 6 dB.

20 HF, LF and SLF OUTPUT Connectors

Electronically balanced outputs from each of the C20A channels — HF (high frequency), LF (low frequency) and SLF (super-low frequency). Nominal output level/impedance is +4 dB/150 Ω . The pin connections are the same as for the input connector.

21 [MODE] Switch

Select the C20A access mode:

- **VARIABLE:** no protect function is active. Edit and store operations can be performed.
- **LOCK OUT:** all front-panel keys are locked out and have no effect on the C20A's operation. All MIDI data other than a bulk dump request is also ignored. Programs 1 through F can be selected via the REMOTE connector.
- **PROTECT:** the internal memory is protected and can not be overwritten by either a front-panel STORE operation or MIDI bulk data reception. The chart below indicates which functions can and can not be accessed in the PROTECT mode:

STORE	NO	
RECALL	NO	
EDIT	CHANNEL DELAY	NO
	OFFSET DELAY	YES
	COMP PARAMETERS	YES
	EQ PARAMETERS	YES
	SLF PARAMETERS	NO
	LF PARAMETERS	NO
	HF PARAMETERS	NO
MIDI	MUTE PARAMETERS	YES
	PROGRAM CHANGE	YES
	PARAMETER SETUP	YES
	MEMORY BULK DUMP	NO
	PROGRAM CHANGE BULK DUMP	NO
	SYSTEM SETUP BULK	NO
REMOTE	YES	

22 MIDI IN and OUT Connectors

MIDI IN accepts MIDI program change or control change messages to select specific memory locations or control assigned EQ parameters (LINK function), respectively, MIDI OUT allows program data to be "bulk dumped" to a second C20A or MIDI data storage device .

[Details on page 19]

23 REMOTE Connector

Accepts a custom-built contact-closure system for remote memory location selection.

[Details on page 19]

SETUP AND PROGRAM SELECTION PROCEDURE

Setup and storing programs

The C20A provides you with the following 5 types of parameter combinations as preset programs.

- ① S1520S
- ② S1525S
- ③ SM1525
- ④ S1520S + SW1820S
- ⑤ S1525S + SW1820S

When you use the C20A with a speaker system, please refer to the instructions of the speaker system which you will use with the C20A.

Setup & Input Level Matching

Follow the procedure below for setting up and storing programs.

1. Set the INPUT level control to "0" and set the rear panel MODE switch to "VARIABLE".
2. Turn the C20A POWER switch ON (the power amplifiers do not have to be turned ON yet).
3. Feed the program signal to the C20A and , while watching the IN level meter, gradually rotate the INPUT level control clockwise. Set the INPUT level control so that the red CLIP segment of the level meter lights only occasionally on brief high-level transients.
4. Turn on the power amplifiers and set the relative balance of the system. It is usually best to balance the super-low, low and high-frequency levels of the system by using the input sensitivity controls of the power amplifiers (or the Y20/Y25/Y30 processor when it is used). Some fine-tuning of overall balance may also be accomplished by using the SLF, LF and HF GAIN parameters (see page 12 & 13) of the C20A. Excessive attenuation of these digital-domain controls may result in less-than-optimum signal-to-noise performance.

Program Selection

If you are using the C20A with the S1525S and Y25, begin by selecting program number 2. Program 2 has been pre-programmed for optimum performance with these components. You should only have to make slight adjustments to match room conditions.

Memory locations 6 through F contain initial data that can be used as a basis for original programs designed for other amplifier and speaker systems. Original programs can be stored in any memory location by using the store procedure described on page 16. If you accidentally erase the preset data by storing to memory location number, the utility mode "INITIALIZE NO. 1-5" function makes it possible to restore the pre-programmed data (see page 18).

1. Use the MEMORY [\triangleleft] and [\triangleright] keys to select the desired program — the selected program number will flash on the LED display to indicate that the program has been selected but not recalled (the previously selected program is still active).
2. Press the [RECALL] key to actually recall and activate the selected program — the recalled program number will light continuously.

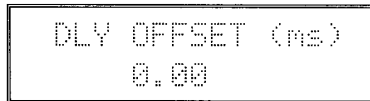
DELAY SETTINGS

1. Press the [DELAY] key to access the delay parameters. Each time the [DELAY] key is pressed the display will alternate between the individual channel delay parameters and the overall delay offset parameter.
2. Use the [←] and [→] key to move the underline cursor to the required parameter (except in the “DLY OFF-SET” page, which only has one parameter).
3. Use the PARAMETER [↕] and [⇄] keys to set the value of the selected parameter. The [↕] or [⇄] key can be held for continuous incrementing or decrementing. Faster incrementing or decrementing can be achieved by pressing the opposite key while holding the [↕] or [⇄] key.



In this display the S, L and H parameters set the individual delay times of the SLF, LF and HF channels, respectively. The delays can be displayed in milliseconds, meters or feet, depending on the setting of the utility mode DELAY DISPLAY function (see page 17).

- DLY(ms) : 0 ... 1300 milliseconds (0.02 ms steps)
- DLY(m) : 0 ... 442 meters (6.8 mm steps)
- DLY(f) : 0 ... 1450 feet 1.5 inches (0.27 inch steps)



The delay offset parameter sets an overall delay offset for the SLF, LF and HF channels. The delay time for each channel is the delay offset plus the individual delay setting for that channel. The DLY OFFSET display also appears in meters or feet, according to the utility mode DELAY DISPLAY setting.

- DLY(ms) : 0 ... 1300 milliseconds (0.02 ms steps)
- DLY(m) : 0 ... 442 meters (6.8 mm steps)
- DLY(f) : 0 ... 1450 feet 1.5 inches (0.27 inch steps)

Time Alignment

Time alignment is essential to achieving optimum sound quality in critical multi-amped sound reinforcement systems and other commercial sound installations. The C20A makes accurate time alignment quick and easy to achieve, in addition to providing a high-quality programmable electronic crossover system.

Time alignment makes it possible to eliminate phase differences between speaker output at the crossover frequencies which, if left unresolved, can cause severe frequency response aberrations and unsuitable imaging at and around the crossover points. Refer to the example on next page.

In this example, the 100-millimeter distance between the zero-phase points of the midrange drivers and high-frequency horn results in almost 180 degrees phase difference — the worst possible case. This situation can be resolved quite easily with the C20A by setting the LF channel delay to about 0.3 millisecond — or 102 millimeters if the display mode is set to meters. Fine adjustment is best carried out by ear.

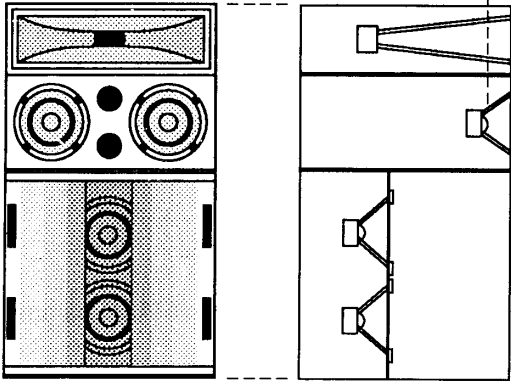
Distance Delay Compensation

In any sound reinforcement setup where rear fill speakers are used to feed sound to audience members located at some distance from the stage and main house speaker system — but still within earshot of the main system — delay between the sound heard from the auxiliary and main speakers can cause anything from subtle unintelligibility to complete confusion.

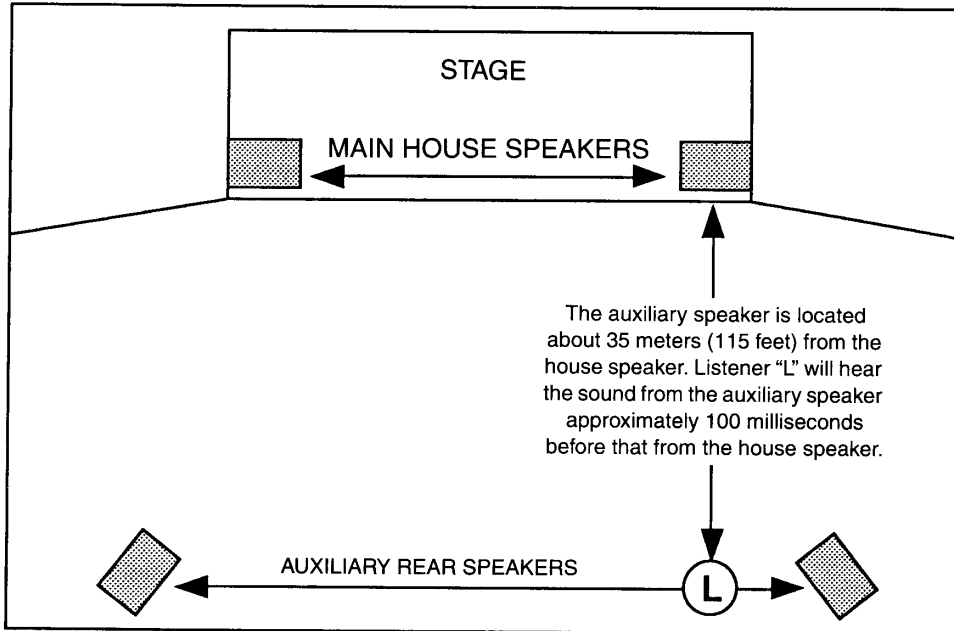
Referring to the diagram on next page, we can see that even relatively short distances can add up to considerable delays. Since the speed of sound in the air is approximately 343 meters/1127 feet per second (at 20°C or 68°F), a mere 35 meters results in a delay of around 100 milliseconds — more than enough to seriously degrade the quality of the sound. Delays of less than about 50 milliseconds can be ignored because the “precedence effect” causes listeners to discern only the initial sound. Longer delays, however, should be compensated. In the example case, the C20A could be set to delay the auxiliary speaker sound by about 100 milliseconds (35 meters or 115 feet, depending on the display mode), thereby restoring the integrity of the sound for all listeners.

$$\text{Wavelength} = \frac{\text{Speed of Sound (approx. 343 meters/sec. or 1127 feet/sec.)}}{\text{Frequency in Hertz}}$$

With a crossover frequency of 5,000 Hz (wavelength = $343/5,000 = 0.0686$ meters or 68.6 mm), a distance of 100 mm equals almost one and a half wavelengths, putting signals from the midrange driver and high-frequency horn approximately 180° out of phase at and around the crossover frequency.



Higher frequencies from cone-type speaker originate primarily at center of cone (dome), while the zero-phase point for a horn is generally at the mouth of the horn. If the zero-phase points of two drivers are not aligned, their output will most likely be out of phase at the crossover frequency.



CHANNEL PARAMETER SETTING

The dividing filter parameters for the SLF, LF and HF channels are accessed and edited in basically the same way as the delay parameters:

1. Press the [SLF], [LF] or [HF] key to access the parameters for the desired channel. Each time the [SLF], [LF] or [HF] key is pressed the next display "page" will appear.
2. Use the [◀] and [▶] keys to move the underline cursor to the required parameter.
3. Use the PARAMETER [⬆] and [⬇] keys to set the value of the selected parameter.
The [⬆] or [⬇] key can be held for continuous incrementing or decrementing. Faster incrementing or decrementing can be achieved by pressing the opposite key while holding the [⬆] or [⬇] key.

SLF (Super Low Frequency) Channel Parameters

```
SLF GAIN= 0.0dB  
PHASE=NOR
```

This display page includes GAIN and PHASE parameters for the SLF channel.

- GAIN: +6 dB ... 0 dB ... -6 dB (0.5 dB steps)
- PHASE: NOR (normal) or REV (reverse)

```
SLF - LPF  
F= 100 SL.=THRU
```

The "SLF - LPF" display includes the frequency and filter slope parameters for the SLF channel low-pass filter.

- F (Cutoff Frequency): 40 Hz ... 2 kHz (1/6 oct. steps)
- SL (Slope): THRU, 6, 12BW, 12LR, 18BW, 18LR, 24BW, 24LR

Note: "BW"= Butterworth
"LR"= Linkwitz Riley
see page 13 for an explanation of these filter types.

```
SLF - HPF  
F= 20 SL.=18BW
```

The "SLF - HPF" display includes the frequency and filter slope parameters for the SLF channel high-pass filter.

- F (Cutoff Frequency): 20 Hz ... 100 Hz (1/6 oct. steps)
- SL (Slope): THRU, 6, 12BW, 12LRD, 18BW, 18LR

LF (Low Frequency) Channel Parameters

```
LF GAIN= 0.0dB  
PHASE=NOR
```

This display page includes GAIN and PHASE parameters for the LF channel.

- GAIN: +6 dB ... 0 dB ... -6 dB (0.5 dB steps)
- PHASE: NOR (normal) or REV (reverse)

```
LF - LPF  
F=1.3k SL.=24LR
```

The "LF - LPF" display includes the frequency and filter slope parameters for the LF channel low-pass filter.

- F (Cutoff Frequency): 80 Hz ... 10 kHz (1/6 oct. steps)
- SL (Slope): THRU, 6, 12BW, 12LR, 18BW, 18LR, 24BW, 24LR

```
LF - HPF  
F= 45 SL.=18BW
```

The "LF - HPF" display includes the frequency and filter slope parameters for the LF channel high-pass filter.

- F (Cutoff Frequency): 20 Hz ... 2 kHz (1/6 oct. steps)
- SL (Slope): THRU, 6, 12BW, 12LR, 18BW, 18LR, 24BW, 24LR

```

LF-PEQ  Q=0.20
F= 200  G= -2

```

The "LF - PEQ" display includes the Q factor, center frequency and gain parameters for the LF channel parametric equalizer.

- Q (Q factor): 0.1 ... 40 (log steps)
- F (Center Frequency): 20 Hz ... 10 kHz (1/6 oct. steps)
- G (Gain): -40 dB ... 0 dB ... +12 dB (1 dB steps)

```

HF-PEQ  Q= 5.0
F= 18k  G=+12

```

The "HF - PEQ" display includes the Q factor, center frequency and gain parameters for the HF channel parametric equalizer.

- Q (Q factor): 0.1 ... 40 (log steps)
- F (Center Frequency): 80 Hz ... 20 kHz (1/6 oct. steps)
- G (Gain): -40 dB ... 0 dB...+12 dB (1 dB steps)

HF (High Frequency) Channel Parameters

```

HF GAIN=-5.5dB
PHASE=NOR

```

This display page includes GAIN and PHASE parameters for the HF channel.

- GAIN: +6 dB ... 0 dB ... -6 dB (0.5 dB steps)
- PHASE: NOR (normal) or REV (reverse)

```

HF - HPF
F=1.3k SL.=24LR

```

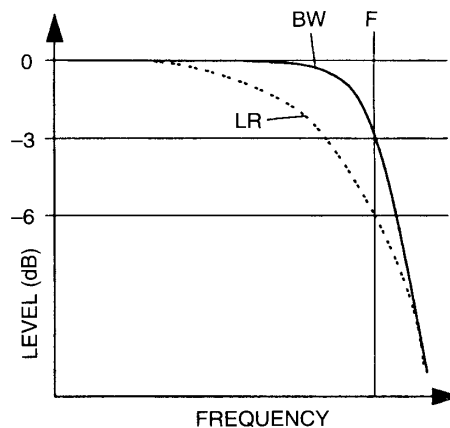
The "HF - HPF" display includes the frequency and filter slope parameters for the HF channel high-pass filter.

- F (Cutoff Frequency): 80 Hz ... 10 kHz (1/6 oct. steps)
- SL (Slope): THRU, 6, 12BW, 12LR, 18BW, 18LR, 24BW, 24LR

Filter Slope Variations

The 12, 18 and 24 dB/oct. cutoff slopes for the C20A high-pass and low-pass filters are available in two variations: "BW" and "LR". The BW response produces a slope that is 3 dB down at the crossover frequency, while the LR response produces a slope that is 6 dB down.

– Filter Response Chart –



Note: The optimum settings for a given sound system will depend on the type of speakers used and other factors, and are best determined by ear. Aim for a smooth frequency response, with no noticeable dips or peaks around the crossover frequency. The only rule is that the LPF and HPF slopes for the same crossover point should be set to the same attenuation value to avoid phase differences that may adversely affect the response at and around the crossover frequency.

EQ SETTINGS

Three overall equalization modes are provided to compensate for bass response aberrations caused by large speaker stacks, high-end loss over distance and general room conditions. Please note that compensation EQ does not apply to the SLF channel.

1. Press [EQ] key to access the compensation EQ parameters. Press the [EQ] key as many times as necessary to call the "STACKING", "DISTANCE" or "ROOM COND." display.
2. Use the PARAMETER [↵] and [⇐] keys to set the value of the selected compensation mode.

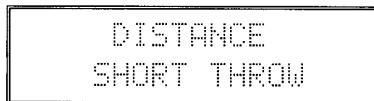
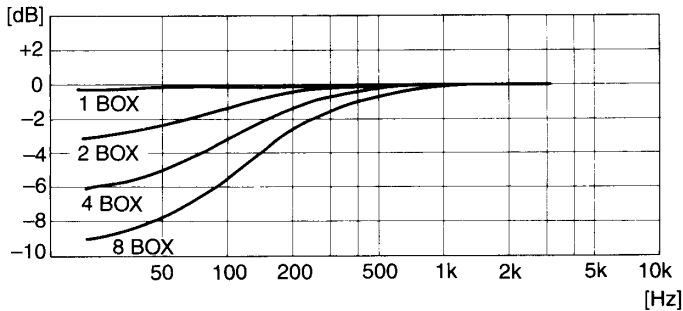


This function attenuates the low frequency output to compensate for the bass boost that often occurs in stacked speaker systems.

- STACKING: 1 BOX, 2BOX, 4BOX, 8BOX

The 1, 2, 4 and 8 box settings correspond to an attenuation of 0, -3, -6 or -9 dB at 70 Hz.

- STACKING Response -

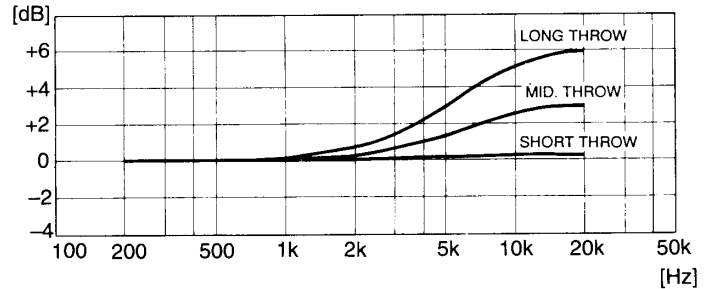


This function boosts the high frequencies to compensate for the high-end loss that occurs over long speaker to listener distances.

- DISTANCE: SHORT, MID, LONG

The SHORT, MID and LONG settings correspond to a high-frequency boost of 0, +3 or +6 dB at 7 kHz.

- DISTANCE Response -



Adjusts overall response to compensate for dead, normal or live room conditions.

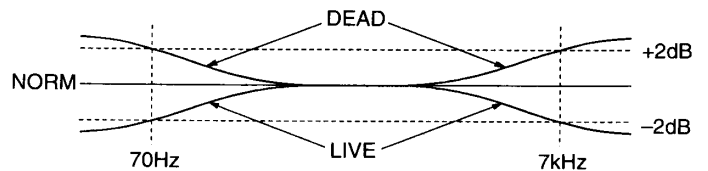
- ROOM COND.: DEAD, NORM, LIVE

Use the DEAD setting for environments that tend to absorb and deaden the low and high frequencies.

The NORM setting produces a flat response that is best for well-designed halls and listening rooms.

The LIVE setting should be used in high reflective environments which tend to emphasize the lows and highs.

- ROOM COND. Response -



COMPRESSOR/LIMITER SETTINGS

The [COMP] key access four display pages that include individual compressor/limiter parameters for the LF and HF channels. No compression/limiting is provided on the SLF channel.

1. Press the [COMP] key to access the compressor/limiter parameters. Each time the [COMP] key is pressed the next display "page" will appear.
2. Use the [◀] and [▶] keys to move the underline cursor to the required parameter.
3. Use the PARAMETER [⬆] and [⬇] keys to set the value of the selected parameter. The [⬆] or [⬇] key can be held for continuous incrementing or decrementing. Faster incrementing or decrementing can be achieved by pressing the opposite key while holding the [⬆] or [⬇] key.

```

LF  COMP.
TH= +8 RA=1.4:1
    
```

```

LF  COMP.
AT= 10 RE=.50
    
```

The above two display pages include the threshold, ratio, attack time and release time parameters for the LF channel compressor/limiter.

- TH (Threshold level): -6 dB ... +14 dB (1 dB steps)
- RA(Ratio): 1:1 1.2:1 1.4:1 1.7:1 2:1 2.5:1 3:1 5:1 10:1 20:1 40:1 ∞:1
- AT (Attack Time): 1 ms ... 20 ms
- RE (Release Time): 0.01 sec ... 2.0 sec

```

HF  COMP.
TH=+14 RA= 20:1
    
```

```

HF  COMP.
AT=3.2 RE=.30
    
```

The above two display pages include the threshold, ratio, attack time and release time parameters for the HF channel compressor/limiter.

- TH (Threshold level): -6 dB ... +14 dB (1 dB steps)
- RA(Ratio): 1:1 1.2:1 1.4:1 1.7:1 2:1 2.5:1 3:1 5:1 10:1 20:1 40:1 ∞:1
- AT (Attack Time): 1 ms ... 20 ms
- RE (Release Time): 0.01 sec ... 2.0 sec

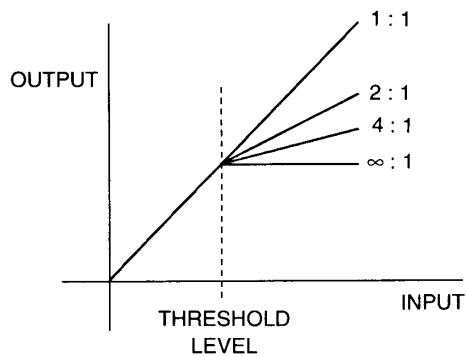
The threshold level determines the input signal level above which compression or limiting begins.

The "∞:1" ratio setting produces limiting while all others produce varying degrees of compression.

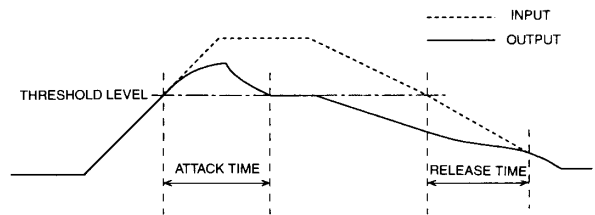
The attack time parameter determines how long it takes for compression or limiting to begin after the input signal exceeds the threshold level.

The release time parameter determine how long it takes before compression or limiting is released after the input signal falls below the threshold level.

– Ratio & Threshold –

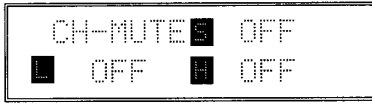


– Attack/Release Time with Ratio = ∞:1 –



MUTE SETTINGS

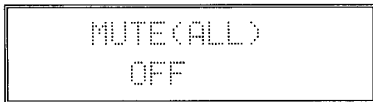
The [MUTE] key accesses functions that make it possible to individually mute the SLF, LF or HF channels, or to mute all channels at once.



The parameters available in this display page allow SLF, LF and HF channel muting to be turned ON or OFF independently. Please note that the channel muting functions will only operate if the MUTE (ALL) function (below) is tuned OFF.

- SLF: ON, OFF
- LF: ON, OFF
- HF: ON, OFF

The selected channel is muted (no output) when its parameter is turned "ON".



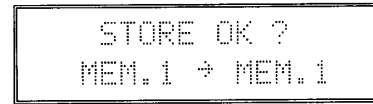
Turn this function ON to mute all three C20A channels at once.

- MUTE (ALL): ON, OFF

PROGRAM STORE

Once you have finished editing a program, it can be stored to the current memory location for later recall and use. If you do not store the edited program and a different program number or mode is selected, the edited program will be lost (the previous program in that memory location remains unchanged).

1. When finished editing, press the [STORE] key. A display similar to the following will appear, asking you to confirm the fact that you want to store the edited data to the current memory location.



The program number will also flash on the MEMORY LED display.

2. Press the [STORE] key a second time to actually store the data. "MEMORY STORE" will appear while the data is being stored. When the store operation is finished, the MEMORY LED display will stop flashing.

Note: It is also possible to store edited data to memory location number 1-5, thus erasing the preset settings. The preset settings can be restored by using the "INITIALIZE NO. 1-5" function in the utility mode (see page 17).

UTILITY MODE FUNCTIONS

Utility mode functions include title edit, delay display unit and MIDI setup. These functions do not affect the audio process directly.

515205

Use the MEMORY [\triangleleft] and [\triangleright] keys to select the number of the memory you wish to set. (The display on the left shows the Memory number 1:S1520S.)

Press the [UTILITY] key once to display the title edit. After this, every time you press the [UTILITY] key, the function display changes in the following order. However, if you pressed the [RECALL] key in Utility mode and exited this mode, the display will first show the display that was shown when you pressed the [RECALL] key, if the unit enters Utility mode again. You may also use the MEMORY [\triangleleft] and [\triangleright] keys to change the function display.

- 515205
TITLE EDIT

★ TITLE EDIT

You can change the title of any program to your own original name (up to 15 characters). Move the [\triangleleft] and [\triangleright] key underneath the character you wish to change, and press the PARAMETER [\triangleleft] and [\triangleright] keys to change the character. These changes will automatically be saved when you exit the Utility mode.

• Characters available and the order in which they are displayed.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
T	U	V	W	X	Y	Z	á	ä	b	c	d	e	f	g	h	i	j	
k	l	m	n	o	ö	p	q	r	s	t	u	ü	v	w	x	y	z	
ア	イ	ウ	エ	オ	カ	キ	ク	ケ	コ	サ	シ	ス	セ	ソ	タ	チ	ツ	テ
ト	ナ	ニ	ノ	ハ	ヒ	フ	ブ	ペ	ボ	バ	ビ	ブ	パ	ピ	プ	ポ	プ	ペ
4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2
°	°	-	[]	<	>	:	.	*	+	-	=	&	/	,	.	'	
%	!	?	→	←	#		0	1	2	3	4	5	6	7	8	9		

* You can erase a character by pressing the Memory STORE key.

DELAY DISPLAY
UNIT : SECOND

★ DELAY DISPLAY UNIT

You can select the display units for the delay time and offset delay time that are displayed by the [DELAY] key. Options are "SECOND", "METER" and "FEET". Use the PARAMETER [\triangleleft] and [\triangleright] keys .

LEVEL METER
PEAK HOLD: OFF

★ LEVEL METER (IN, SLF, LF, HF) PEAK HOLD ON/OFF

Here you can switch the input/output level meter's peak hold function ON or OFF.

MIDI CONTROL
CHANNEL: OMNI

★ MIDI CONTROL CHANNEL settings

Set the MIDI receive/transmit channel using the PARAMETER [\triangleleft] and [\triangleright] keys.
 OMNI = The unit receives data on all MIDI channels and transmits data on channel 1.
 1CH = The unit receives and transmits data on Channel 1.
 2CH = The unit receives and transmits data on Channel 2.
 ⋮
 ⋮
 16CH = The unit receives and transmits data on Channel 16.
 OFF = The unit does not receive or transmit MIDI data.

MIDI PGM CHANGE
PGM 1 = MEM 1

★ *Setting the MIDI Program Change Table*

Using the MIDI Program Change Table, you can assign a program memory number to a MIDI Program Change Message (PGM), as shown in the chart below. The program memory can then be recalled by sending the corresponding Program Change Message. Move the cursor to the numeric field of PGM, then to the MEM field (Program Memory) and set the value using the PARAMETER [\triangleleft] and [\triangleright] keys.

```
PGM 1 = MEM ?
PGM 2 = MEM ?
PGM 3 = MEM ?
      :
      :
PGM 128 = MEM ?
```

- When the cursor is located on PGM, the PGM value and the currently selected MEM value can be changed at the same time. However, when the cursor is located on MEM, only the MEM value can be changed.
- If you set “-” instead of the MEM value, the memory will not be selected even when the unit receives the Program Change Message that corresponds with the program number.

BLUK OUT ALL
MEM* PGM-TBL SYS

★ *MIDI BULK OUT*

This setting allows you to select what MIDI data will be transmitted as Bulk Dump to an externally connected MIDI device.

ALLAll the program data (1 through F), Program Change Table and the Utility mode settings will be transmitted.

That is, all the data described below (MEM*, PGM-TBL and SYS) will be transmitted altogether.

MEMData from a single program will be transmitted by specifying the memory number (1 through F). If MEM* is set, the data of all programs will be transmitted.

PGM-TBLOnly the Program Change Table data will be transmitted.

SYSThe Utility mode settings will be transmitted (excluding the Program Change Table data).

Position the cursor next to one of the above options, then press the [STORE] key to transmit the Bulk Dump data.

INITIALIZE #1?
S15205

★ *INITIALIZING MEMORY NUMBERS 1–5*

You can initialize (reset) the parameter values for memory numbers 1 — 5 to their default values (factory setting). Press the [UTILITY] key several times until the display shown on the left appears. Use the PARAMETER [\triangleleft] and [\triangleright] keys to select the memory number to be initialized.

The upper line on the LCD shows the memory number, and lower line shows the title. Confirm that the memory number that you wish to initialize is selected, then press the [STORE] key . After showing the display on the left for a second, the selected memory's parameter values will be initialized to the factory setting.

- Initializing the data will erase the program data that was stored in that memory number. If you want to keep the previous data, first move the data to another memory number before executing initialization.
- Make sure that the MODE switch on the rear panel has been switched to VARIABLE. If it is set to PROTECT, pressing the [STORE] key will not allow you to select the memory number of the data to be initialized.
- Initialization does not affect the other programs.

INITIALIZE #1?
EXECUTE

S15205

Exiting Utility mode (Returning to MEMORY program)

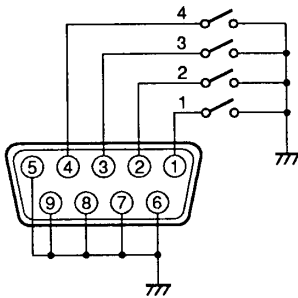
To exit Utility mode, press and hold down the [UTILITY] key for about one second.

HARD-WIRED PROGRAM SELECTION

The 9-pin D-SUB REMOTE connector on the C20A rear panel allows hard-wired remote selection of programs 1 through F. The connector should be wired as follows — using shielded cable. Also avoid long cable runs which might pick up noise.

Pins 5 ... 9 must be grounded. Grounding various combinations of pins 1 ... 4 selects program numbers 1 through F as shown in the chart below.

		Recalled Program Number														
		1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Pin Status (○ = ON, × = OFF)	1	○	×	○	×	○	×	○	×	○	×	○	×	○	×	○
	2	×	○	○	×	×	○	○	×	×	○	○	×	×	○	○
	3	×	×	×	○	○	○	○	×	×	×	×	○	○	○	○
	4	×	×	×	×	×	×	×	○	○	○	○	○	○	○	○



- * If more than one pin (1 ... 4) is grounded at the same time, the lowest-numbered pin takes priority.
- * If at least one pin (1 ... 4) is grounded, the front panel keys and MIDI reception are locked out.

MIDI LINK

This function allows two C20A units connected via a MIDI cable to be programmed simultaneously. This means that in stereo setups in which both channels require the same parameter settings, the editing procedure need only be carried out once.

In practice, one C20A functions as the “master” and the other as the “slave”. Connect a MIDI cable from the MIDI OUT of the master unit to the MIDI IN of the slave unit. Any parameter changes made on the master unit will then be transmitted directly to the slave unit as well. This occurs regardless of MIDI channel settings. The MIDI link function will not operate, however, if the rear panel MODE switch is set to the “LOCK OUT” position

SPECIFICATIONS

Electrical Characteristics

Frequency Response	20 Hz — 20 kHz
Dynamic Range	Greater than 100 dB
Total Harmonic Distortion	Less than 0.03 % (1 kHz)

Input

Number of Inputs	1 (Electronically balanced)
Nominal Level	+4 dB
Input Impedance	20 k Ω

Outputs

Conversion Type	Delta-Sigma
Number of Outputs	3 (Electronically Balanced)
Nominal Level	+4 dB
Output Impedance	150 Ω

A/D, D/A Conversion

Quantization	18 bits
Sampling Rate	50 kHz

Delay Time 0 — 1.3 sec (0.02 ms steps)

Memory

Number of Locations	15:1 through F
---------------------	----------------

MIDI In/Out Program change for memory select, bulk dump for up/down load

External Control Connector 9-pin D-SUB (contact-closure memory select)

Displays

Level Meter	INPUT/OUTPUT 1 — 3
Memory Number	7-segment LED
Parameter	16-char. x 2-line, backlit

Power Requirements

U.S. & Canadian models	120 V, 60 Hz
General model	230 V, 50 Hz

Power Consumption 22 W

Dimensions (W x H x D) 480 x 45.2 x 324 mm (18-7/8" x 1-3/4" x 12-3/4")

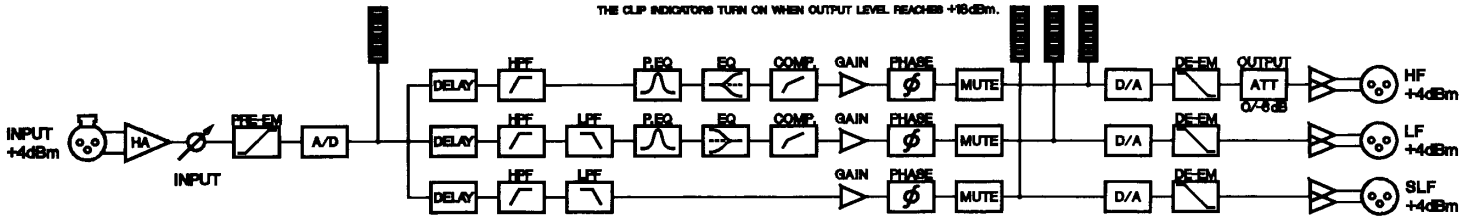
Weight 3.8 kg (8 lbs 6 oz)

* 0 dB = 0.775 volts RMS.

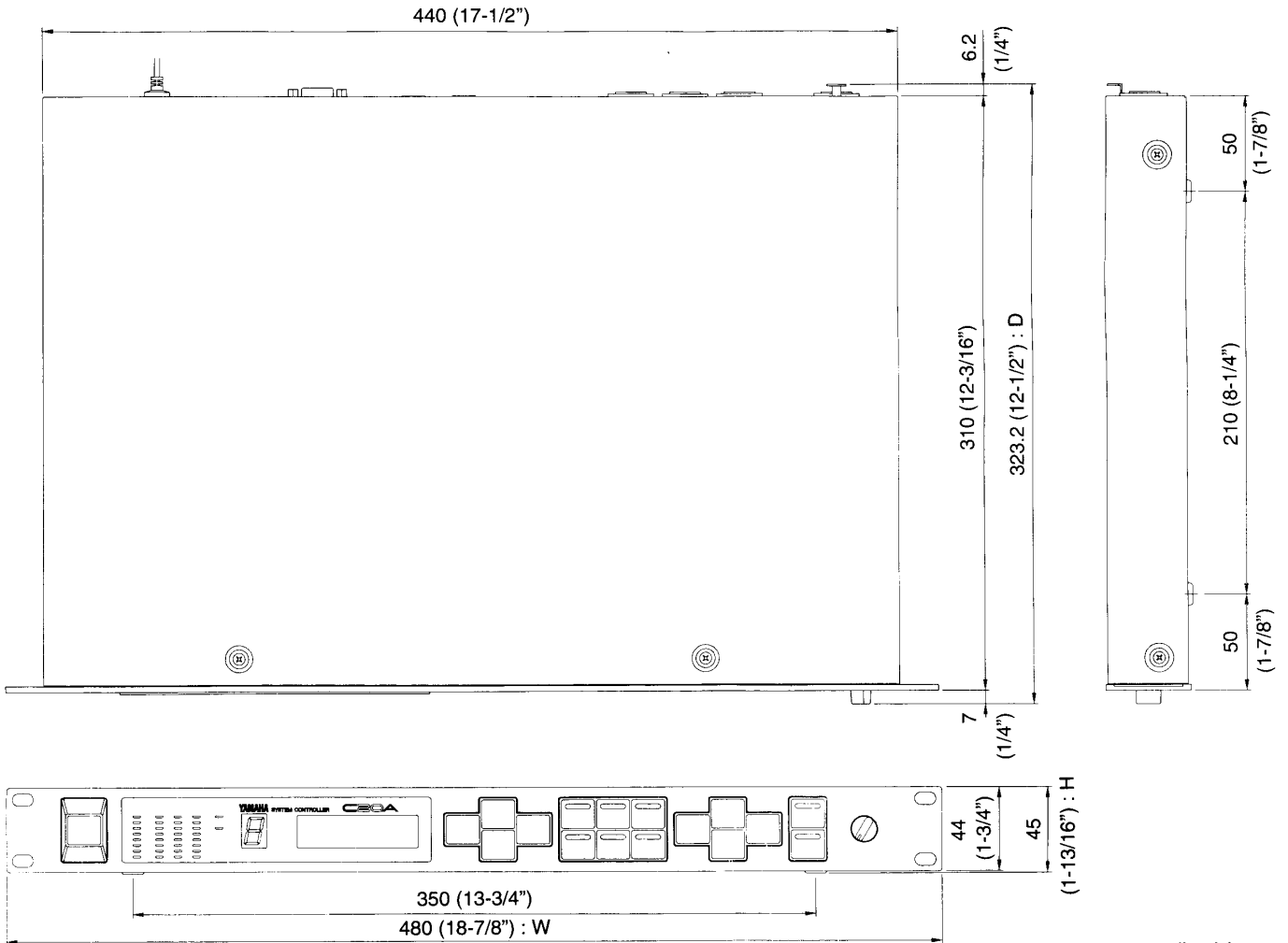
** Specifications and appearance may be changed without notice.

*** Internal circuit delays result in an overall delay of approximately 0.9 msec even when the individual channel delays and overall delay offset are set to zero.

BLOCK DIAGRAM



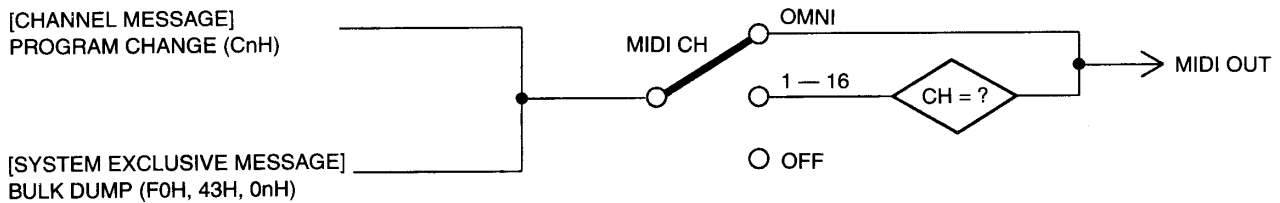
DIMENSIONS



Unit: mm (inch)

MIDI DATA FORMAT

1. Transmission Conditions



2. Transmission Data

All MIDI Data to transmitted only when the Transmission Channel is set to OMNI on 1—16.

2-1 Program Change

Transmitted whenever a program is recalled.

```
status      1100 nnnn (CnH)  nnnn=channel # *1
1st data    0ppp pppp      ppppppp=program # *2
```

2-2 Bulk Dump

The data group to be bulk dumped is selected in the utility mode bulk dump function - MEM(No.), MEM* PGM-TBL, SYS, ALL.

• 1 Memory Bulk Data

The data in the current; selected memory location is transmitted.

```
status      1111 0000 (FOH) System exclusive
ID #        0100 0011 (43H) YAMAHA
sub status  0000 nnnn (0nH)  nnnn=device # *3
format #    0111 1110 (7EH) Universal bulk dump
byte count  0000 0001 (01H) header and data
              0000 0100 (04H) =132bytes
header      0100 1100 (4CH) "L"
              0100 1101 (4DH) "M"
              0010 0000 (20H) " "
              0010 0000 (20H) " "
              0011 1000 (38H) "8"
              0011 0111 (37H) "7"
              0011 0100 (34H) "4"
              0011 0110 (36H) "6"
              0100 1101 (4DH) "M" ; 1 memory data
              0mmmm mmmmm   mmm mmmmm=memory # *4
data        0000 aaaa      1st byte *5
              0000 bbbb      2nd byte
              }
              0000 aaaa      121th byte
              0000 bbbb      122th byte
check sum   0eee eeee      *7
EOX         1111 0111 (F7H) End of exclusive
```

• All Memory (15) Bulk Data [MEM*]

The "1 Memory Bulk Data" described above is transmitted 15 times - once for each memory location.

• Program Change Table Bulk Data [PGM-TBL]

Transmit Program Change Table Data.

```
status      1111 0000 (FOH) System exclusive
ID #        0100 0011 (43H) YAMAHA
sub status  0000 nnnn (0nH)  nnnn=device # *3
format #    0111 1110 (7EH) Universal bulk dump
byte count  0000 0001 (01H) header and data
              0000 1010 (0AH) =138bytes
header      0100 1100 (4CH) "L"
              0100 1101 (4DH) "M"
              0010 0000 (20H) " "
              0010 0000 (20H) " "
              0011 1000 (38H) "8"
              0011 0111 (37H) "7"
              0011 0100 (34H) "4"
              0011 0110 (36H) "6"
              0101 0100 (54H) "T" ; Table data
              0000 0001 (01H) bank #=1
data        0mmmm mmmmm   1st byte *4
              0mmmm mmmmm   2nd byte
              }
              0mmmm mmmmm   127th byte
              0mmmm mmmmm   128th byte
check sum   0eee eeee      *7
EOX         1111 0111 (F7H) End of exclusive
```

• System Setup Bulk Data [SYS]

Transmit System Data.

```
status      1111 0000 (FOH) System exclusive
ID #        0100 0011 (43H) YAMAHA
sub status  0000 nnnn (0nH)  nnnn=device # *3
format #    0111 1100 (7CH) Universal bulk dump
byte count  0000 0000 (00H) header and data
              0000 1111 (0FH) =15bytes
header      0100 1100 (4CH) "L"
              0100 1101 (4DH) "M"
              0010 0000 (20H) " "
              0010 0000 (20H) " "
              0011 1000 (38H) "8"
              0011 0111 (37H) "7"
              0011 0100 (34H) "4"
              0011 0110 (36H) "6"
              0101 0011 (53H) "S" ; System data
version #   0vvv vvvv      version # (integer)
              0vvv vvvv      version # (decimal fraction)
data        0ddd dddd      Delay Unit data
              0ddd dddd      Peak Hold data
              0ddd dddd      MIDI Channel # data
check sum   0eee eeee      *7
EOX         1111 0111 (F7H) End of exclusive
```


- **All Memory, Program Change Table, and System Setup Bulk Data [All]**

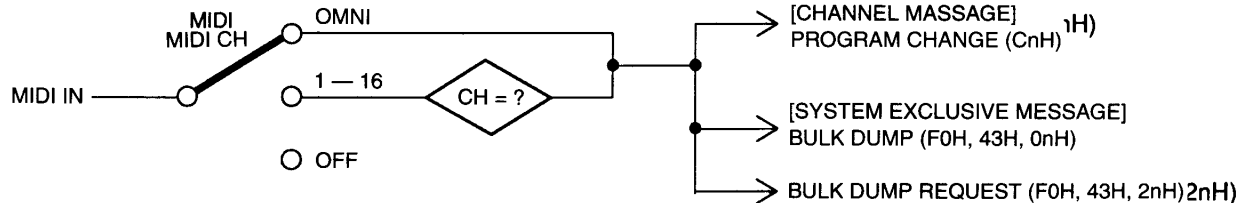
The “All Memory Bulk Data,” “Program Change Table Bulk Data,” and “System Setup Bulk Data” transmissions described above are carried out in sequence.

- **Parameter Setup**

Transmitted when parameter data is edited.

status	1111 0000 (F0H)	System exclusive
ID #	0100 0011 (43H)	YAMAHA
sub status	0000 nnnn (0nH)	nnnn=device # *3
format #	0111 1100 (7CH)	Condition setup
byte count	0000 0000 (00H)	header and data
	0001 0001 (11H)	=17bytes
header	0100 1100 (4CH)	"I"
	0100 1101 (4DH)	"M"
	0010 0000 (20H)	" "
	0010 0000 (20H)	" "
	0011 1000 (38H)	"8"
	0011 0111 (37H)	"7"
	0011 0100 (34H)	"4"
	0011 0110 (36H)	"6"
	0101 0000 (50H)	"P" ; Parameter change
	0010 0000 (20H)	" "
version #	0vvv vvvv	version # (integer)
	0vvv vvvv	version # (decimal fraction)
data	0ppp pppp	parameter #
	0000 aaaa	1st data *6
	0000 bbbb	2nd data
	0000 cccc	3rd data
	0000 dddd	4th data
check sum	0eee eeee	*7
EOX	1111 0111 (F7H)	End of exclusive

3. Reception Conditions



4. Reception Data

4-1 Program Change

The data received is the same as that described in “Program Change” in the preceding “Transmission Data” section.

4-2 Bulk Dump

- **1 Memory Bulk Data**

The data received is the same as that described in “1 Memory Bulk Data” in the preceding “Transmission Data” section.

- **All Memory (15) Bulk Data [MEM*]**

The data received is the same as that described in “All Memory (15) Bulk Data” in the preceding “Transmission Data” section.

- **Program Change Table Bulk Data [PGM-TBL]**

The data received is the same as that described in “program Change Table Bulk Data” in the preceding “Transmission Data” section.

- **System Setup Bulk Data [SYS]**

The data received is the same as that described in “System Setup Bulk Data” in the preceding “Transmission Data” section.

- **All memory, Program Change Table, and System Setup Bulk Data [ALL]**

The data received is the same as that described in “All Memory, Program Change Table, and System Setup Bulk Data” in the Preceding “Transmission Data” section.

- **Parameter Setup**

The data received is the same as that described in “Parameter Setup” in the preceding “Transmission Data” section. The parameters of the currently selected program are changed accordingly when this data is received.

4-3 Bulk Dump Request

• Memory Data Bulk Dump Request

```

status      1111 0000 (F0H) System exclusive
ID #        0100 0011 (43H) YAMAHA
sub status  0010 nnnn (2nH) nnnn=device # *3
format #    0111 1110 (7EH) Universal bulk dump
header      0100 1100 (4CH) "L"
            0100 1101 (4DH) "M"
            0010 0000 (20H) " "
            0010 0000 (20H) " "
            0011 1000 (38H) "8"
            0011 0111 (37H) "7"
            0011 0100 (34H) "4"
            0011 0110 (36H) "6"
            0100 1101 (4DH) "M" ; 1 memory data
            0mmm mmmm      mmmm mmmm=User's
                           memory # *4
EOX         1111 0111 (F7H) End of exclusive
  
```

• Program Change Table Bulk Dump Request

```

status      1111 0000 (F0H) System exclusive
ID #        0100 0011 (43H) YAMAHA
sub status  0010 nnnn (2nH) nnnn=device # *3
format #    0111 1110 (7EH) Universal bulk dump
header      0100 1100 (4CH) "L"
            0100 1101 (4DH) "M"
            0010 0000 (20H) " "
            0010 0000 (20H) " "
            0011 1000 (38H) "8"
            0011 0111 (37H) "7"
            0011 0100 (34H) "4"
            0011 0110 (36H) "6"
            0101 0100 (54H) "T" ; Table data
            0000 0001 (01H) bank #=1
EOX         1111 0111 (F7H) End of exclusive
  
```

• System Setup Data Bulk Dump Request

```

status      1111 0000 (F0H) System exclusive
ID #        0100 0011 (43H) YAMAHA
sub status  0010 nnnn (2nH) nnnn=device # *3
format #    0111 1110 (7EH) Universal bulk dump
header      0100 1100 (4CH) "L"
            0100 1101 (4DH) "M"
            0010 0000 (20H) " "
            0010 0000 (20H) " "
            0011 1000 (38H) "8"
            0011 0111 (37H) "7"
            0011 0100 (34H) "4"
            0011 0110 (36H) "6"
            0101 0011 (53H) "S" ; Syetem data
            0010 0000 (20H) " "
EOX         1111 0111 (F7H) End of exclusive
  
```

NOTE

- * 1 nnnn=0 (channel 1) ~15 (channel 16)
- * 2 ppppppp=0 (program 1) ~127 (program 128)
- * 3 nnnn=0 (device 1) ~15 (device 16)
- * 4 mmmmmmm=1 (MEM 1) ~15 (MEM15)
- * 5 The upper and lower 4 bits of each byte are separated and transmitted as 2 bytes.

For example, the byte "aaaa bbbb" are transmitted as follows:

```

aaaa bbbb → 0000 aaaa
            0000 bbbb
  
```

* 6 1-byte and 2-byte data is separated into 4-bit groups and transmitted as 4 bytes.

For example, the two bytes "aaaa bbbb cccc dddd" are transmitted as follows:

```

aaaa bbbb → 0000 aaaa
            0000 bbbb
  
```

```

cccc dddd → 0000 cccc
            0000 ddd
  
```

The single byte "ccc dddd" is transmitted as follows:

```

            0000 0000
            0000 0000
cccc dddd → 0000 cccc
            0000 dddd
  
```

* 7 "eeeeeee" is the two's complement of the lower 7 bits of the sum of the header and data bytes.

* 8 Parameter number

0		SLF		
1	DELAY	LF		
2		HF		
3		OFFSET		
4	COMP	LF	THRESHOLD	
5			PATIO	
6			ATTACK	
7			RELEASE	
8		HF	THRESHOLD	
9			RATIO	
10			ATTACK	
11			RELEASE	
12			EQ	STACKING
13				DISTANCE
14				ROOM CONDITION
15	SLF	GAIN		
16		PHASE		
17		LPF	FREQUENCY	
18			SLOPE	
19		HPF	EREQUENCY	
20			SLOPE	
21		LF	GAIN	
22			PHASE	
23			LPF	FREQUENCY
24				SLOPE
25	HPF		EREQUENCY	
26			SLOPE	
27	PEQ		FREQUENCY	
28			GAIN	
29			Q	
30	HF		GAIN	
31			PHASE	
32		HPF	FREQUENCY	
33			SLOPE	
35		PEQ	GAIN	
36			Q	
37		MUTE	SLF	
38			LF	
39	HF			

Function ...	Transmitted	Recognized	Remarks
Basic Default	: 1 - 16, off	: 1 - 16, off	: memorized
Channel Changed	: 1 - 16, off	: 1 - 16, off	:
Mode Default	: x	: OMNIoff/OMNIon	: memorized
Mode Messages	: x	: x	:
Mode Altered	: *****	: x	:
Note	: x	: x	:
Number : True voice	: *****	: x	:
Velocity Note ON	: x	: x	:
Velocity Note OFF	: x	: x	:
After Key's	: x	: x	:
Touch Ch's	: x	: x	:
Pitch Bender	: x	: x	:
	: x	: x	:
Control	:	:	:
Change	:	:	:
Prog	: 0 0 - 14	: 0 0 - 127	: *1
Change : True #	: *****	:	:
System Exclusive	: 0	: 0	:
System : Song Pos	: x	: x	:
System : Song Sel	: x	: x	:
Common : Tune	: x	: x	:
System :Clock	: x	: x	:
Real Time :Commands	: x	: x	:
Aux :Local ON/OFF	: x	: x	:
Aux :All Notes OFF	: x	: x	:
Mes- :Active Sense	: x	: x	:
sages:Reset	: x	: x	:
Notes: *1 = For program 1 - 128, memory #1 - #F is selected.			
Mode 1 : OMNI ON, POLY	Mode 2 : OMNI ON, MONO	o : Yes	
Mode 3 : OMNI OFF, POLY	Mode 4 : OMNI OFF, MONO	x : No	

YAMAHA

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