Product Manual

ICE-HE

Ethernet Head-End Controller
Version 3.5 May 31, 2016
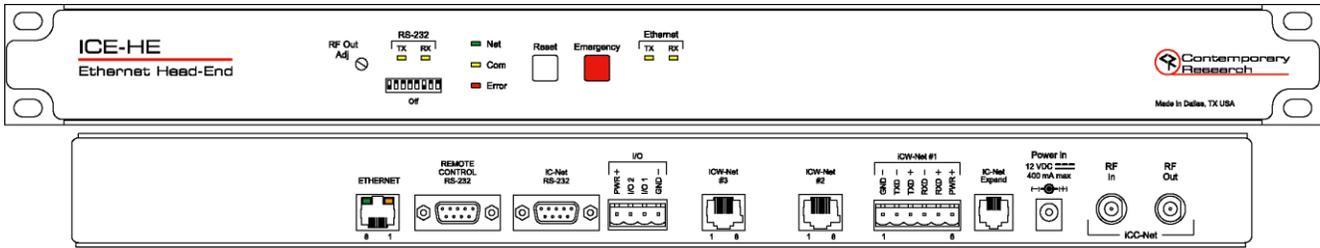
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Overview

Contemporary Research introduces a new solution for intelligent television control and distributed media management, the ICE-HE Ethernet Head-End. Through a single Ethernet port, the ICE-HE can network thousands of iC-Net TV controllers, communicating over the same CATV cable that carries the media channels.

The industry-standard iC-Net protocol operates seamlessly over Ethernet networks, RS-232 control ports, RF coax, Cat5 wiring, and fiber optic cables. Our Display Express software or custom control systems can easily integrate all TV and video projectors across a facility or campus.

The ICE-HE typically distributes 1-way control over RF, operating in the gap between channels 4 and 5, without interfering with any other channel. 2-way control is available for legacy systems.

Applications include educational television systems, presentation rooms, auditoriums, pay-per-view, theme parks, museums and industrial video networks.

- Connects to RS-232 or Ethernet network via 10/100baseT port using a static IP address
- Networks with up to 4,000 TVs through in-house RF cable systems
- Sends commands to individual devices, zones, or all units from a single RS-232 port
- Interacts with CR Display Express software or custom control systems
- Provides LED feedback for network, control, and operation status

Specifications
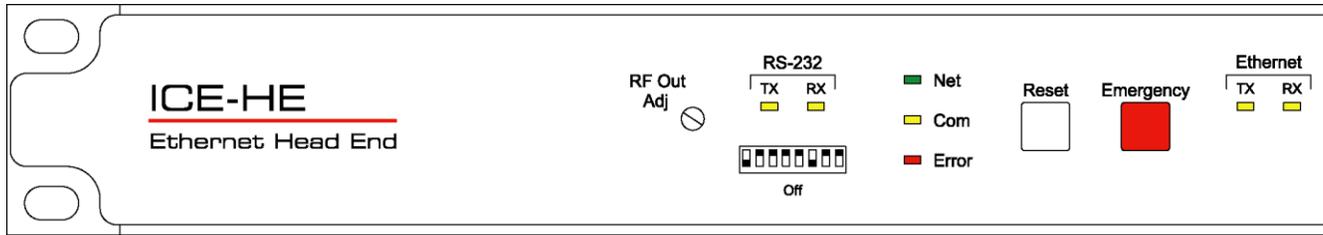
Physical

|	
Size:	19" [483mm] wide x 1.75" [38mm] height (1RU) x 9" [229mm] deep
Weight:	3 lbs [1.36kg]
Enclosure:	All aluminum with durable black powder coat paint
Mounting:	Shelf or 19" equipment rack (mounting brackets included)

Front Panel

RF Out Adjust: Trims iCC-Net channel output, shipped set to +55 dBmV (max)
RS-232 TX LED: Yellow LED, lights when receiving RS-232 data on Remote Control RS-232 port
RS-232 TX LED: Yellow LED, lights when receiving RS-232 data on Remote Control RS-232 port
RS-232 DIP Switch: Sets RS-232 baud rate (9600 - 38.4K), 8 data bits, no parity, 1 stop bit
Switch 1 selects high/low sensitivity for RF In signal
Switch 2 resets HE IP settings to default
Switches 6, 7, and 8 set RS-232 baud rate

DIP	Off	On
1	RF In Low*	RF In High
2	*	Reset IP
3		
4		
5		
6	Baud	
7	Baud	
8	Baud	

Baud	6	7	8
38,400	ON	ON	ON
19,200*	OFF	ON	ON
9,600	ON	OFF	ON
4,800	OFF	OFF	ON
2,400	ON	ON	OFF
1,200	OFF	ON	OFF

*Default setting

Net LED: Green LED for iC-Net bus, flashes once per second if network is operating, device numbers expected agree
The LED will flash twice per second if the number of present and expected devices do not agree
COM LED: Yellow LED blinks when a valid command is received or system response sent through the Remote Control RS-232 port
Error LED: Red LED indicates that the control channel frequency is in error, requires service
Reset/Default: White button sends press and release RS-232 response to PC software or control system
Emergency: Red button sends press and release RS-232 response to PC software or control system
Ethernet RX/TX: Yellow LEDs indicate Ethernet data send and receive
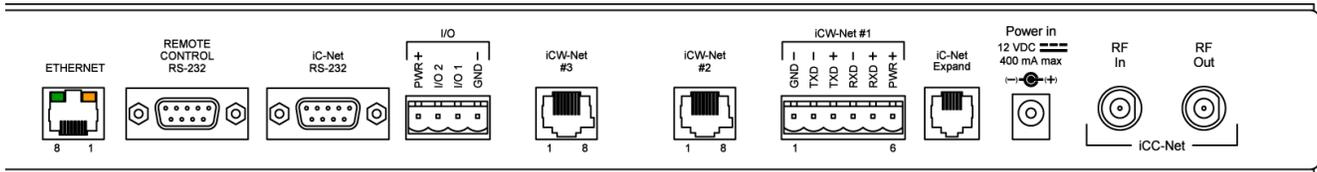
Control Connections

Ethernet: 10/100baseT RJ-45 jack, RCX/TX LEDs indicate Ethernet data send and receive

Left LED	Right LED	Indication
Off	Off	No link
Off	Solid Amber	100BASE-T Half Duplex link
Off	Blinking Amber	100BASE-T Half Duplex link, activity
Off	Solid Green	100BASE-T Full Duplex link
Off	Blinking Green	100BASE-T Full Duplex link, activity
Solid Amber	Off	10BASE-T Half Duplex link
Blinking Amber	Off	10BASE-T Half Duplex link, activity
Solid Green	Off	10BASE-T Full Duplex link
Blinking Green	Off	10BASE-T Full Duplex link, activity

Control RS-232:   DB9 female, RS-232 data link to control system or PC

RS-232 Control Port

5 GND	GND 5
2 RXD	TXD 3
3 TXD	RXD 2

9-pin D-sub female
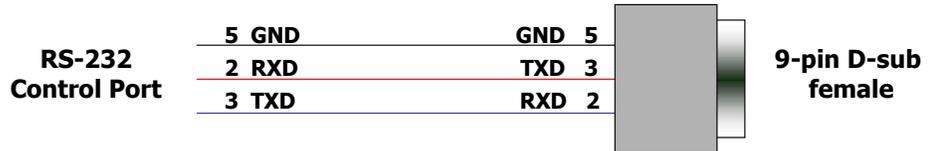
iC-Net RS-232:   DB9 female, RS-232 data link to send iCW-Net over fiber or codec
I/O 1 & 2:   4-pin captive screw terminal for Input/Outputs 1 and 2
                         2 switch closures or inputs, max 50 mA, 24 VDC, switch to GND

    1 – +12 VDC
    2 – Output 2
    3 – Output 1
    4 – GND

I/O Applications: DC power – close pins 1 & 3 to provide DC on/off
                         Dry closure 2 – close pins 3 & 4 for dry contact to external power relay,
                         AMX PC1 or similar
                         Sense closure (3 & 4) on Input 1 – trigger control system to power off for all rooms

iCC-Net Connections

RF In: 'F', female, 75 ohm impedance, RF and iCC-Net from CATV system
Data Receive: Carried over the same RF coax connection as TV channels
                         Return signal from system controllers
                         Sub-band, 5.6MHz, narrow-band signal below standard sub-band channels
                         -15 to +35 dBmV signal level (0 to +15 dBmV nominal)
RF Out: F', female, 75 ohm impedance, RF to CATV distribution to controllers
Data Transmit: Mid-band VHF, 74.7 MHz, narrow-band signal between channels 4 and 5
                         ± 80 KHz max carrier deviation
                         +55 dBmV maximum (default)

iCW-Net Connections (Legacy Systems)

|	
iCW-Net 2, 3	RJ-45 female 8 pin Telco jack, supports 3300 ft [1 km] of wire
	RS-422/485 type data requiring at least 2 twisted wire pairs with shield or fifth conductor
iCW-Net 1:	6-pin captive-screw terminal for system wiring or use with RS-422/485-format fiber or codecs
iC-Net Expand	RJ-11 female 6-pin Telco jack
Recommended Wire:	CAT5/CAT3 compatible unshielded, max 3,300 feet [1 Km] from Head End

Power Connections

Power In:	2.1mm coaxial jack (inside center conductor positive),
	11 to 18 VDC, 12 VDC typical, 300 mA maximum (may be unregulated)
	UL/CSA listed wall power supply (included for domestic 110 VAC/60 Hz shipments only)

Includes

10 dB and 20 dB RF attenuators
12 VDC Power Supply

Installation – 1-Way
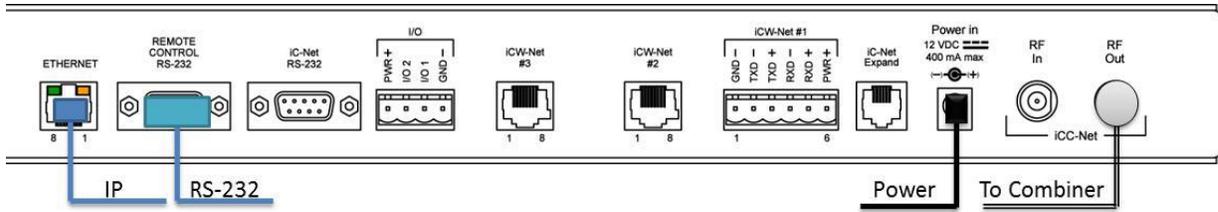
Remote Control Connection
- Attach appropriate RS-232 cable to the **Remote Control** RS-232 port. See page 5 for RS-232 cable wiring diagram.
- The default setting is 19.2K baud – see page 4 for DIP switch setting information. Do not change for use with Display Express systems.
- Alternatively, connect via Ethernet, setup instructions on page 9.

RF Coax and iCC-Net Operation
- Connect an RF coax feed from RF Out to the system's RF combiner, mixing the iCC-Net Out signal with the other CATV channels. The iCC-Net Out channel operates at 74.7 MHz, in between cable channels 4 and 5.
- When combining the RF output with QMOD modulators, add the included 20 dB attenuator – this will lower the output to match the QMOD's 29 dB
- Using an RF signal level meter, use the front panel RF Out adjustment counterclockwise to match the other sources, attenuates the level by up to -10 dBmV.
- Do not connect any feeds to RF In.

AC Power and Net LED operation
- Insert DC power supply plug into the Power In jack.
- Plug power adaptor into AC wall outlet, the front-panel LEDs should turn on momentarily.
- If iC-Net communication is functioning, the Net LED will twice per second.

I/O Port Connection
1. A simple contact closure can be wired to I/O 1 or 2, a press or release can trigger events in the PC or control system software.
2. In other applications, the I/O ports can act as closure outputs, activating an external power relay, 2x1 video switcher or other device.
3. You'll have to choose application – the ports act as either an output or input, not both. See Control Connections on page 5 for wiring and rating information.

Installation – 2-Way
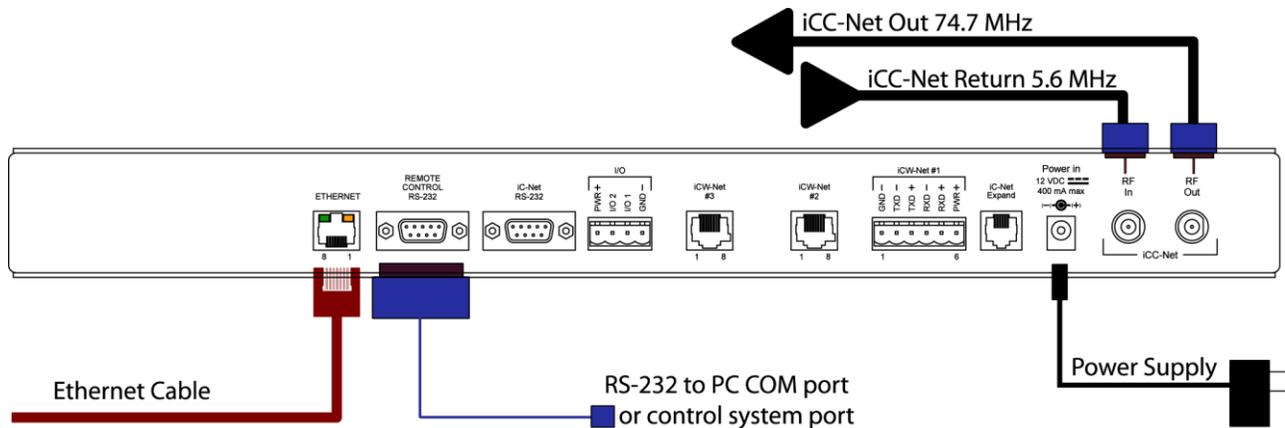
RF Coax and iCC-Net Operation

1. Connect an RF coax feed from RF Out to the system's RF combiner, mixing the iCC-Net Out signal with the other CATV channels. The iCC-Net Out channel operates at 74.7 MHz, in between cable channels 4 and 5.
2. When combining the RF output with QMOD modulators, add the included 20 dB attenuator – this will lower the output to match the QMOD's 29 dB. 10 dB attenuators are included for use in 45 dB systems.
3. Using an RF signal level meter, use the front panel RF Out adjustment counterclockwise to match the RF Out signal to the other CATV sources. Limit RF Out adjustment to -10 dB, using attenuators to achieve a lower signal strength.
4. Add a Sub-CATV Diplexer after the CATV amplifier.
5. Connect the Sub-Channel output of the Diplexer to the HE RF In connection.

Ethernet Setup

Ethernet Connection

The ICE-HE typically communicates over a network using a static IP address, and is shipped set to a default address:

> IP Address: 192.168.1.251
> Subnet Mask: 255.255.255.0
> Gateway Address: 000.000.000.000

Odds are, at least the IP address will need to change when the ICE-HE is connected to the client's network. One your first steps will be to obtain a static address from the client's IT department, as well as an external gateway IP address if you intend on supporting the system from your office or anywhere outside the site's firewall.

Once you change the settings, create a label noting the settings and attach to the back of the ICE-HE.

Reset IP Address

If you change the default address and forget what it is later on, you can always reset the ICE-HE back to the default settings using the unit's front-panel DIP switch 2. While the power is on, flip the switch off, then back on to reset the IP address. The IP and Subnet Mask will revert, the Gateway will stay at its current setting.

Since its possible another network device is using the default IP address, the best approach is to enter the new settings offline, outside the network –and you'll need a static address approved by the IT team.

Currently, we've removed the **Java** applet we used to use for Web page setup, and will be replacing that with a simpler, Java-free Web page. Existing units will have the standard Home page and the Java applet. But new versions of Java may not let you use the app.

For now, use a Terminal app to change the IP address over RS-232.

Changing the IP address via RS-232

You can communicate with the ICE-HE with a Terminal app. If you don't have one, download Tera Term, a free (and safe) app.

Settings are: 19200 baud, 8 bits, no parity, 1 stop bit, no flow control

For Tera Term, you define the COM port then after you connect, go to **Setup/Terminal** to turn on local echo, go to **Setup/Serial** to for port settings.

Use the IP command by itself to see current settings, and then enter the settings you need.

You could use Telnet, Port 2728 – but it's easier to change the network settings without getting into the network hassles in the first place.

RS-232/Telnet HE Commands

Command		Description
		Commands shown in ASCII and end with carriage return (Decimal 13, Hex $0D, or Enter key). Response displays * character to signify end of characters, or time out if no characters are received after 2 seconds. Tip: Just hit Enter to repeat any Terminal command, ESC to clear or cancel current command
Echo Enable	EN	Enables character echo so you can see typed characters on screen. Or use the Terminal settings to Local Echo.
Echo Disable	EF	Disables terminal character display (default).
Version	VE ID IB	Displays HE software version Displays HE software version Displays HE boot loader software version
Reset	Z!	Performs system reset.

Show Devices	SD	Displays list of 2-way devices stored in HE memory. List can be created by iC Commander software, ABC-MRC software, or Scan and Build command below.
		Example Response: Devs Present:
		                257-261
		                 263
		                265-271*

Show Missing	SM	Displays list of missing 2-way devices (compared to HE memory list).
		
		Example Response: Devs Missing:
		                262 -263
		                264*

Show Present	SP	Displays number of present devices and number of devices expected. Example Response: Num Devs Present : 1 Num Devs Expected : 53*
Show Numbers	SN	Displays number of present devices and number of devices expected. Example Response: SN 0001/0053*
Scan and Show	SZ	Scans iC-Net and displays list of all 2-way devices found (does not change HE memory).
Scan and Build	Z^	Scans iC-Net and saves list of all 2-way devices found into HE memory.
Show Log	L	Returns four hex bytes, separated by commas. If any of the bytes change as you repeat the command, there is likely an error in return communication from iC-Net devices.
Clear Log	DL	Clears the L hex bytes to zero.

RF Receive Level	AR	Level RF Received (idle) background level, no units constantly transmitting
		Example Responses:
		  AR RRRR/SSSS = Receive/Sensitivity levels
		  AR 0321/1337 = 0.321V "quiet" receive level, 1.337V high threshold
		  AR 0321/0693 = 0.321V "quiet" receive level, 0.693V low threshold
		  AR 2250/0693 = 2.251V constant transmit receive level, 0.693V low threshold
		
		This command is used to check RF levels at 5.6MHz, compared to the current sensitivity level setting (DIP Switch 1, page 4). Test the RF receive level a few times when the iC-Net units are not transmitting, then again when one iC-Net unit is set to constantly transmit. The Sensitivity level should fall about halfway between quiet and constant transmit RF levels.

RF Output	AO	Displays RF output level Example Response: AO 5000* (Full Output)
DIP Setting	AS	Displays DIP switch setting in binary format Example Response: AS 222* (Switches 1 and 6 off)

Command		Description

IP Address	**IP**	IP returns the current MAC address, Ethernet firmware version, current IP address, subnet mask, and gateway. Response example (S or D at end of IP signifies DHCP or Static address):
		
		  MAC address 00204A80E637
		  Lan Software version 01.6 (040308) XPTE
		  $IP=192.168.001.251S IG=000.000.000.000 IM=255.255.255.000
		
		IP = xxx.xxx.xxx.xxx Defines IP address, then sends status (0.0.0.0 = DHCP)

IG Gateway	**IG**	IG = Returns current MAC address, Ethernet firmware version, current IP information IG = xxx.xxx.xxx.xxx Defines IP gateway, then sends status
IM Subnet	**IM**	IM = Returns current MAC address, Ethernet firmware version, current IP information IM = xxx.xxx.xxx.xxx Defines IP subnet mask, then sends status

RS-232 ICC-Net Control Protocol

Overview

RS-232 control for up to 4000 iC-Net devices is provided through an iC series Head-End Network Controller. The ICC-HE Head-End manages iC-Net communication over RF Coax to ICC-series devices as well as ICW-series devices over twisted-pair Cat3/5 wiring. The ICW-HE Head-End operates on the Cat5 network only.

Each device is assigned a unique device number from 1 to 4000 to which control commands are addressed. The devices are organized into 16 zones of 255 devices. All the devices in each zone will respond to a single "virtual device number" — one device number that represents all devices in each zone. There is also a global device number, 4095, that will command all devices in the system. This feature dramatically speeds up system operation and programming, because one command can affect an entire group of devices—or all. To take advantages of this feature, review the section iC-Net Zones in this manual.

In ABC-Net Media Retrieval Systems, we reserve the first group of devices, 1-255, for components operating on a connected control system. Zones 1-16 are used for CR TV Controllers, Video Display Controllers and Tuners. As it's unlikely any system will use all 4000 devices, this may be a good device standard for your system as well.

The Remote RS-232 port on the Head-End Network Controller can communicate from 1200 to 38.4K baud. The factory default setting is 19.2K baud, 8 data bits, No parity, and 1 stop bit.

Command String Structure

Characters in command strings are expressed in a combination of hex and ASCII characters.

- Single-byte hex numbers are preceded by the '$' symbol
- ASCII characters or strings are enclosed in single quotes
- Numbers not marked as hex or ASCII are a single decimal byte
- Parameters shown in < > brackets are single byte
- A series of multiple commands or parameters are set apart by [ ] brackets
- Commas separate the bytes, but are not part of the protocol
- Double quotes enclose the command string, but are not part of the protocol

Command format

"$A5,<dh>,<dl>,<ncb>,<cmd1>,<parameter> [<cmdN>]"

$A5	Starts the command
<dh>	The zone or high order byte of the device
<dl>	The unit or low order byte of the device (0 for global zone)
<ncb>	The number of command bytes to follow
<cmd1>	The first command byte
<parameter>	Command parameters (not used by all commands)
[<cmdN>]	Multiple commands can be concatenated, with byte count added to <ncb>

RS-232 HE Commands

The following commands apply to the HE only. Commands addressed to controllers are included with the **Product Manual** for the specific ICC1 and ICC2 device.

Command		Description
Closures	**Y__**	"$A5,0,0,3, 'Y' <I/0 Port>' " (7 bytes) For legacy ICC controllers Turns the two internal closures on and off. Closure 1 is typically used to control the optional buzzer, Closure 2 typically used to control an external camera power relay. "$A5,0,0,3, 'Y10'" turns Closure 1 off "$A5,0,0,3, 'Y11'" turns Closure 1 on "$A5,0,0,3, 'Y20'" turns Closure 2 off "$A5,0,0,3, 'Y21'" turns Closure 2 on
Device Status	**SP**	"$A5,0,0,2,'SP'" (6 bytes) 2-way systems only Queries the Head-End for the number of devices present on the network and the number of devices expected.
Response		**Description**
Key-I/O	**K**	" '<',0,0,2,'K',<IR Key>" (6 bytes) Sent when the Reset or Emergency buttons are pressed, or when I/O 1 or 2 receives a closure. PC software or a control system connected to the Control RS-232 port can receive the response and activate a programmed event. 101 = Reset button pressed 229 = Reset button released 102 = Emergency button pressed 230 = Emergency button released 103 = I/O 1 input closed 231 = I/O 1 input opened 104 = I/O 2 input closed 232 = I/O 2 input opened
Device Query	**SP**	" '<',0,0,4,'SP',<number devices present>,<number devices expected> (8 bytes) Sent in response to HE Device Status query. **Tip**: If the number of present and expected devices match, the green Net LED on the HE will blink once per second. If the two numbers do not agree, the LED blinks twice per second.

iC-Net SmartZones

To simplify controlling groups of devices, iC-Net is divided into 16 zones of 255 devices, also called SmartZones. All the devices within each zone can be controlled simultaneously by sending a command to a single "virtual device number".

For example, noting the SmartZone chart below, if we send a Power On command to device #256, any TV controller numbered between 257 and 511 will instantly turn on. If we send a Power Off command to device #4095, all devices in the system will turn off.

This is an immensely powerful feature, because most systems can only address one device at time. So if you need to turn off all 50 TV in a zone, you would need to send 50 commands. In addition to the hassles of creating multiple commands, there would be a long delay between the first and last command. One command, instant response is easier.

Addresses can be set below 256, however there is no Zone 0 command, so you would need to create groups in Display Express or in system programming.

Zone	First Device	Last Device	Virtual Device
1	257	511	256
2	513	767	512
3	769	1023	768
4	1025	1279	1024
5	1281	1535	1280
6	1537	1791	1536
7	1793	2047	1792
8	2049	2303	2048
9	2305	2559	2304
10	2561	2815	2560
11	2817	3071	2816
12	3073	3327	3072
13	3329	3583	3328
14	3585	3839	3584
15	3841	4000	3840
All Zones			4095

Tip:You've probably figured out that you never want to assign a virtual device number to an actual device in the system. If you assigned #1536 to a device, all the TV controllers in Zone 6 would respond every time you sent a command to that one device.

Safety Instructions

Read before operating equipment.

- Cleaning - Unplug this product from the wall outlet before cleaning. Do not use liquid cleaners or aerosol cleaners. Use a damp cloth for cleaning.
- Power Sources - Use supplied or equivalent UL/CSA approved low voltage DC plug-in transformer.
- Outdoor Antenna Grounding - If you connect an outside antenna or cable system to the product, be sure the antenna or cable system is grounded so as to provide some protection against voltage surges and built-up static charges. Section 810 of the National Electrical Code, ANSI/NFPA No. 70, provides information with respect to proper grounding of the mast and supporting structure, grounding of the lead-in wire to an antenna discharge unit, size of grounding conductors, location of antenna discharge unit, connection to grounding electrodes, and requirements for the grounding electrode.
- Lightning - Avoid installation or reconfiguration of wiring during lightning activity.

Power Lines - Do not locate an outside antenna system near overhead power lines or other electric light or power circuits or where it can fall into such power lines or circuits. When installing an outside antenna system, refrain from touching such power lines or circuits, as contact with them might be fatal.

- Overloading - Do not overload wall outlets and extension cords as this can result in a risk of fire or electric shock.
- Object and Liquid Entry - Never push objects of any kind into this product through openings as they may touch dangerous voltage points or short out parts, resulting in a fire or electric shock. Never spill liquid of any kind on the product.
- Servicing - Do not attempt to service this product yourself as opening or removing covers may expose you to dangerous voltage or other hazards. Refer all servicing to qualified service personnel.
- Damage Requiring Service - Unplug this product from the wall outlet and refer servicing to qualified service personnel under the following conditions:
- When the power supply cord or plug is damaged.
- If liquid spills or objects fall into the product.
- If the product is exposed to rain or water.
- If the product does not operate normally by following the operating instructions. Adjust only those controls that are covered by the operating instructions. An improper adjustment of other controls may result in damage and will often require extensive work by a qualified technician to restore the product to its normal operation.
- If the video product is dropped or the cabinet is damaged.
- When the video product exhibits a distinct change in performance, this indicates a need for service.

* Note to CATV system installer: This reminder is provided to call CATV system installer's attention to Article 820-40 of the National Electrical Code (Section 54 of Canadian Electrical Code, Part I), that provides guidelines for proper grounding and, in particular, specifies that the cable ground shall be connected to the grounding system of the building as close to the point of cable entry as possible.

Limited Warranty and Disclaimer

Warranty: Three (3) year limited warranty on all parts and labor for Contemporary Research manufactured products from the day of purchase by authorized dealer. Manufactured products are warranted against defects in materials and workmanship. If Contemporary Research receives notice of such defects during the warranty period, Contemporary Research will repair or replace, at its option, products that prove to be defective.

Exclusions: The above warranty shall not apply to defects resulting from improper or inadequate maintenance by the customer, customers applied software or interfacing, unauthorized modifications or misuse, mishandling, operation outside the normal environmental specifications for the product, use of the incorrect, modified or extended power supply, or improper site operation and maintenance. *Please note Contemporary Research SSV-DX Display Express PC product carries a six month limited warranty.*

RF Channel Frequencies

Channel	CATV/IRC	HRC	FCC	Chan	CATV	HRC	FCC	Chan	CATV	HRC	FCC	Chan	CATV	HRC	FCC
T Band					**High**			47	361.25	360.0180	669.25	79	553.25	552.0276	861.25
iCC-Net	5.6 (In)			7	175.25	174.0087	175.25	48	367.25	366.0183	675.25	80	559.25	558.0279	867.25
T 7	7.00			8	181.25	180.0090	181.25	49	373.25	372.0186	681.25	81	565.25	564.0282	873.25
T 8	13.00			9	187.25	186.0093	187.25	50	379.25	378.0189	687.25	82	571.25	570.0285	879.25
T 9	19.00			10	193.25	192.0096	193.25	51	385.25	384.0192	693.25	83	577.25	576.0288	885.25
T 10	25.00			11	199.25	198.0099	199.25	52	391.25	390.0195	699.25	84	583.25	582.0291	
T 11	31.00			12	205.25	204.0102	205.25	53	397.25	396.0198	705.25	85	589.25	588.0294	
T 12	37.00			13	211.25	210.0105	211.25	54	403.25	402.0201	711.25	86	595.25	594.0297	
T 13	43.00				**Super**			55	409.25	408.0204	717.25	87	601.25	600.0300	
T14	49.00			23	217.25	216.0108	525.25	56	415.25	414.0207	723.25	88	607.25	606.0303	
Low				24	223.25	222.0111	531.25	57	421.25	420.0210	729.25	89	613.25	612.0306	
2	55.25	54.0027	55.25	25	229.25	228.0114	537.25	58	427.25	426.0213	735.25	90	619.25	618.0309	
3	61.25	60.0030	61.25	26	235.25	234.0117	543.25	59	433.25	432.0216	741.25	91	625.25	624.0312	
4	67.25	66.0033	67.25	27	241.25	240.0120	549.25	60	439.25	438.0219	747.25	92	631.25	630.0315	
iCC-Net	74.7 (Out)*	72.0036		28	247.25	246.0123	555.25	61	445.25	444.0222	753.25	93	637.25	636.0318	
5	77.25/79.2	78.0039	77.25	29	253.25	252.0126	561.25	62	451.25	450.0225	759.25	94	643.25	642.0321	
6	83.25/85.2	84.0042	83.25	30	259.25	258.0129	567.25	**Hype**				100	649.25	648.0324	
FM				31	265.25	264.0132	573.25	63	457.25	456.0228	765.25	101	655.25	654.0327	
95	91.25	90.0045	91.25	32	271.25	270.0135	579.25	64	463.25	462.0231	771.25	102	661.25	660.0330	
96	97.25	96.0048	97.25	33	277.25	276.0138	585.25	65	469.25	468.0234	777.25	103	667.25	666.0333	
97	103.25	102.005	103.25	34	283.25	282.0141	591.25	66	475.25	474.0237	783.25	104	673.25	672.0336	
Mid				35	289.25	288.0144	597.25	67	481.25	480.0240	789.25	105	679.25	678.0339	
98	109.25	108.005	109.25	36	295.25	294.0147	603.25	68	487.25	486.0243	795.25	106	685.25	684.0342	
99	115.25	114.005	115.25	37	301.25	300.015	609.25	69	493.25	492.0246	801.25	107	691.25	690.0345	
14	121.25	120.006	471.25	38	307.25	306.0153	615.25	70	499.25	498.0249	807.25	108	697.25	696.0348	
15	127.25	126.006	477.25	39	313.25	312.0156	621.25	71	505.25	504.0252	813.25	109	703.25	702.0351	
16	133.25	132.006	483.25	40	319.25	318.0159	627.25	72	511.25	510.0255	819.25	110	709.25	708.0354	
17	139.25	138.006	489.25	41	325.25	324.0162	633.25	73	517.25	516.0258	825.25	111	715.25	714.0357	
18	145.25	144.007	495.25	42	331.25	330.0165	639.25	74	523.25	522.0261	831.25	112	721.25	720.0360	
19	151.25	150.007	501.25	43	337.25	336.0168	645.25	75	529.25	528.0264	837.25	113	727.25	726.0363	
20	157.25	156.007	507.25	44	343.25	342.0171	651.25	76	535.25	534.0267	843.25	114	733.25	732.0366	
21	163.25	162.008	513.25	45	349.25	348.0174	657.25	77	541.25	540.0270	849.25	115	739.25	738.0369	
22	169.25	168.008	519.25	46	355.25	354.0177	663.25	78	547.25	546.0273	855.25	116	745.25	744.0372	

Frequencies -—The analog channel visual carrier frequency (channels T7-116) is shown in this chart, in MHz. Add 1.75 to state the center frequency for digital channels

CATV/IRC — IRC spacing is the same as standard CATV frequencies, except for Channels 5 and 6.

HRC/IRC — About 10% of CATV systems use these alternate frequency plans, created to reduce "beat" interference.

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*****Channel 1** — IRC/HRC spacing created a Channel 1 between 4 and 5, the rarely used channel must be shifted to different frequency for IC-Net operation