

**BROADBAND NETWORKS
PART 15 - FREQUENCY OFFSETS**

By Neal McLain

This is Part 15 in a series of articles about coaxial broadband networks.

The first broadband networks were cable television systems intended to carry NTSC television signals. On such systems, many of the visual carrier frequencies are offset from the nominal frequency assignments. Offsets are used for two reasons: FCC requirements and distortion control. In this article, we will discuss both of these reasons in detail.

FCC OFFSET REQUIREMENTS

As we noted in an earlier article, broadband networks are (theoretically at least) closed environments: the entire network is completely contained inside a grounded sheath in which the only openings are carefully-shielded impedance-matched input and output ports.

In fact, broadband networks are subject to "leakage." A leak is any break in the continuity of the sheath which allows RF signals to pass. Leaks can be caused by many factors: defective equipment, improper installation, animal damage, corrosion, wind-induced cracks, vehicle accidents, and/or vandalism. A common source of leakage in cable television systems: poorly-shielded components installed by subscribers attempting to connect additional TV receivers.

Leaks cause both "ingress" and "egress." Ingress is the passage of RF signals from the outside airspace into the network; egress is the passage of RF signals from the network to the outside airspace.

Egress can cause destructive interference to communication signals operating in the outside airspace. Amateur radio operators using the 2-meter ham band

(continued on page 4)

Next Meeting:

**Wednesday,
October 22, 1997**

**Broadcast Clinic:
DTV Preparation and
Panel Discussion**

**Holiday Inn West
1313 John Q. Hammons
Drive, Middleton**

**Meeting of the SBE
Upper Midwest
Region
Meeting and Program
at 7:30pm**

In This Issue:

Minutes	page 2
Amateur Radio News	page 3
EAS Firsthand	page 8
FCC Rulemakings	page 10
Local Legals	page 11

WMSN Tower Removed

By Matt Mommaerts

You may have noticed the Candelabra tower's little brother is missing. The 1000 foot WMSN tower was removed over the course of the last few months by a contracting company of SST Inc. (the company that removed WHA-TV's and WISC's tower). The tower was originally fabricated by Dresser-Ideco in 1955 for KFJZ in Ft. Worth, TX. It is/was a triangular, pin based tower with solid round Manten Steel legs and 10 foot faces.

In 1955, the crew that erected the

tower put a 1955 penny at the base. When the tower was re-located to Madison, the penny stayed with the tower. When the tower was erected here in 1985, a new penny was added to the base and next year, in upstate New York, a new penny will be added to the mix upon erection of the tower.

As with most involved engineering projects, it didn't go easy as planned. Since the tower had been here in this fine Wisconsin weather for the last 12 years, the bolts holding the tower together were kind of sticky. After breaking a fairly large socket wrench or two while trying to free some bolts,

the crew went to bigger and better tools. They graduated to impact wrenches, and those didn't even do the job most of the time. If big tools don't do the job, there's only one thing that will do it for sure. You guessed it, an Acetylene torch! This slowed the dismantling process considerably, not to mention the care that had to be taken with the other tower 70 feet away. Slowly but surely, they kept working. This crew was highly skilled and experienced in tower work which was needed for this job, considering they had to remove guy wires intertwined with the

(continued on page 9)

CHAPTER 24 OFFICERS

CHAIR:

Fred Sperry (Wis. Public TV)
W - 264-9806 FAX - 264-9646
fsperry@mail.state.wi.us

VICE-CHAIR:

Kevin Ruppert (WISC-TV)
W - 271-4321
kruppert@wisctv.com

SECRETARY:

Neal McLain (CTI)
W - 831-4636
nmclain@compuserve.com

TREASURER:

Stan Scharch (WISC-TV)
W - 271-4321
sscharch@wisctv.com

COMMITTEE APPOINTEES

Program Committee:

Mark Croom	271-1025
Denise Maney	277-8001
Kerry Maki	833-0047
Steve Zimmerman	274-1234

Membership and Past-Chair:

Paul Stoffel

Sustaining Membership: Fred Sperry

Strategic Planning: Dennis Behr

Special Events: Kevin Ruppert

Certification and Education:

Jim Hermanson 836-8340
Tim Trendt (UW-Platteville)

Frequency Coordination:

Tom Smith W - 263-2174
smithtc@vilas.uwex.edu

SBE National Board Member & Chapter Liaison:

Leonard Charles
W - 271-4321 FAX - 271-1709
lcharles@wisctv.com

September Business Meeting Minutes

Chapter 24 of the Society of Broadcast Engineers met on Tuesday, September 23, 1997, at Rocky Rococo on Mineral Point Road at the Beltline in Madison, Wisconsin. There were 24 persons in attendance, including 19 members (17 certified) and 5 guests. The meeting was designated "Guest Night".

The meeting was called to order by Chapter 24 Chairman Fred Sperry at 7:00 pm. Sperry greeted the members and guests and thanked Denise Maney for setting up the dinner and meeting room. The members and guests then introduced themselves. The minutes of the August meeting were approved as published in the September Newsletter.

The Treasurer's Report, made by Stan Scharch, indicated that the Chapter is in the black. Newsletter Editor Mike Norton reported that Friday, October 10 at midnight was the deadline for this month's Newsletter. The folding party will be on Wednesday, October 15 at 5:30 at WKOW-TV.

Membership Chairman, Paul Stoffel reported that the Chapter now has 68 members, 38 of which are certified. The Chapter sends out 135 Newsletters. The Sustaining Membership report was made by Fred Sperry, who reported that Hewlett-Packard was a new sustaining member. WMSN, Comark and Niall Enterprises have renewed.

Steve Zimmerman, on behalf of the Program Committee, reminded the meeting that the Wednesday night session of the Broadcasters' Clinic would be the October monthly meeting.

Certification Committee: Jim Hermanson reported that the next exam period would be November 14 to 24. One person was signed up. The deadline to sign up is September 26. Frequency Coordination: Tom Smith reported that there was nothing new.

National News: Fred Sperry reported on behalf of Leonard Charles, that the EAS petition made by the EAS committee was now on the SBE World Wide Web page. The comment period is now closed on the petition. The reply period is closed on October 8.

In Old Business, Chairman Sperry spoke again on the Wednesday night of the Broadcasters' Clinic. The program will start out with David Felland from WMVS talking about their efforts concerning DTV, followed by a panel discussion on what local stations are doing to prepare for DTV. Sperry reported that one or two more speakers were still needed for the panel.

In New Business, Sperry reported that the rebate check from National was received in the amount of \$478.75. The officers voted to keep the rebate, and make a donation to the Ennes Foundation of \$100.00. Although no vote is needed for expenditures of this amount, Sperry asked for a vote anyway. The motion was made, seconded, and was carried.

(continued on next page)

Broadband Networks Part Fifteen (continued)

are well aware of this problem.

The cable television mid- and superbands use visual carrier frequencies which overlap bands assigned to the Federal Aviation Administration:

108-137 MHz
225-400 MHz

The FAA uses these frequency blocks for three services:

- **Aeronautical Mobile.** Two-way communications, mostly voice, with some digital data. Most communications occur between aircraft and ground-based control towers, although communications among aircraft are also permitted. This service occupies three bands, and overlaps several cable channels (Figure 1).

- **VHF Omnidirectional Range (VOR).** VOR transmitters act as radio beacons, allowing pilots to navigate from one VOR transmitter to another by following VOR "radials." This service occupies the 108.0-118.0 MHz band, and overlaps cable channels 98 and 99.

- **Instrument Landing System (ILS).** ILS transmitters guide landing aircraft to runways and heliport landing areas. This service occupies the 328.6-335.4 MHz band, and overlaps cable channel 42.

To protect these FAA services from possible interference from cable system leakage, the FCC has imposed frequency-offset requirements on cable television networks. These requirements apply to any carrier which operates at or above a level of +38.75 dBmV (100 microwatts); this threshold includes virtually all visual carriers but excludes most aural carriers.

The offset requirements are:

- **Aeronautical Mobile:** ±12.5 KHz.
- **VOR and ILS:** ±25.0 KHz.

The FCC rules do not specify whether the offsets must be positive or negative. However, by common cable industry practice, positive offsets are almost universally used.

To illustrate these requirements, here are three examples:

- **Channel 14:** The nominal visual carrier frequency is 121.25 MHz; therefore, it falls in the Aeronautical Mobile band. Applying the required offset yields $121.25 + 0.0125 = 121.2625$ MHz, halfway between Aeronautical Mobile frequencies at 121.2500 and 121.2750 MHz.

- **Channel 42:** The nominal visual carrier frequency is 331.25 MHz; therefore, it falls in the ILS band. Applying the required offset yields $331.25 + 0.0250 = 331.2750$ MHz, halfway between ILS frequencies at 331.2500 and 331.3000 MHz.

- **Channel 98:** The nominal visual carrier frequency is 109.25 MHz; therefore, it falls in the VOR band. Applying the required offset yields $109.25 + 0.0250 = 109.2750$, halfway between VOR frequencies at 109.2500 and 109.3000 MHz.

The allowable frequency tolerance in all cases is ±5 KHz.

The frequency assignment plan of a cable television system, with offsets applied only where required by FCC rules, is called the "standard" plan, and is

reproduced in Figure 2.

IRC: INCREMENTALLY-RELATED CARRIERS

As we noted in last month's article, third-order distortion is the dominant form of distortion in broadband networks carrying a large number of visual carriers. As carriers are added to the network, both second- and third-order distortions increase; however, third-order increases faster, and becomes dominant when the total number of carriers exceeds about 30.

Third-order distortion can be masked through the use of a technique called "Incrementally Related Carriers", or IRC. Using this technique, all visual carriers are phaselocked to harmonics of a single master oscillator in accordance with the following relationship:

$$F(c) = (6*n)+1.2625$$

where n indicates the harmonic of the master oscillator.

For example, consider the combination of Channels 29, 30, and 31. These visual carriers are phaselocked to the 42nd, 43rd, and 44th harmonics, as follows:

$$F(29) = (6*42)+1.2625 = 253.2625 \text{ MHz.}$$

$$F(30) = (6*43)+1.2625 = 259.2625 \text{ MHz.}$$

$$F(31) = (6*44)+1.2625 = 265.2625 \text{ MHz.}$$

One (of many) third-order distortion products generated by this combination of carriers is:

$$253.2625 + 259.2625 - 265.2625 = 247.2625 \text{ MHz}$$

which falls at the Channel 28 visual carrier. Assuming that the Channel 28 visual carrier is also phaselocked to the same master oscillator, the distortion product falls precisely on top of the visual carrier, effectively masking it.

Of course this technique doesn't actually reduce third-order distortion; it simply masks it by aligning it precisely on top of other visual carriers.

FAA Service	Bands (MHz)	Channels Affected	Required Offset
Aeronautical Mobile	118.0 - 137.0	14-16	± 12.5 KHz
	225.0 - 328.6	24-41	± 12.5 KHz
	335.4 - 400.0	43-53	± 12.5 KHz
VHF Omnidirectional Range (VOR)	108.0 - 118.0	98-99	± 25.0 KHz
Instrument Landing System (ILS)	328.6 - 335.4	42	± 25.0 KHz

Figure 1. FAA Radio Service bands which overlap Cable TV channels. FCC offset requirements may be satisfied with either positive or negative offsets; by industry practice, positive offsets are almost universally used.

(continued on page 6)

Broadband Networks Part Fifteen (continued)

Band (in MHz)	Cable Channel	Standard Carrier Frequency	IRC Carrier Frequency	HRC Carrier Frequency	Master Oscillator Harmonic	Band (in MHz)	Cable Channel	Standard Carrier Frequency	IRC Carrier Frequency	HRC Carrier Frequency	Master Oscillator Harmonic
54 - 60	2	55.2500	55.2625	54.0027	9	432 - 438	59	433.2500	433.2625	432.0216	72
60 - 66	3	61.2500	61.2625	60.0030	10	438 - 444	60	439.2500	439.2625	438.0219	73
66 - 72	4	67.2500	67.2625	66.0033	11	444 - 450	61	445.2500	445.2625	444.0222	74
72 - 76	1	73.2625	72.0036		12	450 - 456	62	451.2500	451.2625	450.0225	75
76 - 82	5	77.2500	79.2625	78.0039	13	456 - 462	63	457.2500	457.2625	456.0228	76
82 - 88	6	83.2500	85.2625	84.0042	14	462 - 468	64	463.2500	463.2625	462.0231	77
90 - 96	95	91.2500	91.2625	90.0045	15	468 - 474	65	469.2500	469.2625	468.0234	78
96 - 102	96	97.2500	97.2625	96.0048	16	474 - 480	66	475.2500	475.2625	474.0237	79
102 - 108	97	103.2500	103.2625	102.0051	17	480 - 486	67	481.2500	481.2625	480.0240	80
108 - 114	98	109.2750			18	486 - 492	68	487.2500	487.2625	486.0243	81
114 - 120	99	115.2750			19	492 - 498	69	493.2500	493.2625	492.0246	82
120 - 126	14	121.2625	121.2625	120.0060	20	498 - 504	70	499.2500	499.2625	498.0249	83
126 - 132	15	127.2625	127.2625	126.0063	21	504 - 510	71	505.2500	505.2625	504.0252	84
132 - 138	16	133.2625	133.2625	132.0066	22	510 - 516	72	511.2500	511.2625	510.0255	85
138 - 144	17	139.2500	139.2625	138.0069	23	516 - 522	73	517.2500	517.2625	516.0258	86
144 - 150	18	145.2500	145.2625	144.0072	24	522 - 528	74	523.2500	523.2625	522.0261	87
150 - 156	19	151.2500	151.2625	150.0075	25	528 - 534	75	529.2500	529.2625	528.0264	88
156 - 162	20	157.2500	157.2625	156.0078	26	534 - 540	76	535.2500	535.2625	534.0267	89
162 - 168	21	163.2500	163.2625	162.0081	27	540 - 546	77	541.2500	541.2625	540.0270	90
168 - 174	22	169.2500	169.2625	168.0084	28	546 - 552	78	547.2500	547.2625	546.0273	91
174 - 180	7	175.2500	175.2625	174.0087	29	552 - 558	79	553.2500	553.2625	552.0276	92
180 - 186	8	181.2500	181.2625	180.0090	30	558 - 564	80	559.2500	559.2625	558.0279	93
186 - 192	9	187.2500	187.2625	186.0093	31	564 - 570	81	565.2500	565.2625	564.0282	94
192 - 198	10	193.2500	193.2625	192.0096	32	570 - 576	82	571.2500	571.2625	570.0285	95
198 - 204	11	199.2500	199.2625	198.0099	33	576 - 582	83	577.2500	577.2625	576.0288	96
204 - 210	12	205.2500	205.2625	204.0102	34	582 - 588	84	583.2500	583.2625	582.0291	97
210 - 216	13	211.2500	211.2625	210.0105	35	588 - 594	85	589.2500	589.2625	588.0294	98
216 - 222	23	217.2500	217.2625	216.0108	36	594 - 600	86	595.2500	595.2625	594.0297	99
222 - 228	24	223.2500	223.2625	222.0111	37	600 - 606	87	601.2500	601.2625	600.0300	100
228 - 234	25	229.2625	229.2625	228.0114	38	606 - 612	88	607.2500	607.2625	606.0303	101
234 - 240	26	235.2625	235.2625	234.0117	39	612 - 618	89	613.2500	613.2625	612.0306	102
240 - 246	27	241.2625	241.2625	240.0120	40	618 - 624	90	619.2500	619.2625	618.0309	103
246 - 252	28	247.2625	247.2625	246.0123	41	624 - 630	91	625.2500	625.2625	624.0312	104
252 - 258	29	253.2625	253.2625	252.0126	42	630 - 636	92	631.2500	631.2625	630.0315	105
258 - 264	30	259.2625	259.2625	258.0129	43	636 - 642	93	637.2500	637.2625	636.0318	106
264 - 270	31	265.2625	265.2625	264.0132	44	642 - 648	94	643.2500	643.2625	642.0321	107
270 - 276	32	271.2625	271.2625	270.0135	45	648 - 654	100	649.2500	649.2625	648.0324	108
276 - 282	33	277.2625	277.2625	276.0138	46	654 - 660	101	655.2500	655.2625	654.0327	109
282 - 288	34	283.2625	283.2625	282.0141	47	660 - 666	102	661.2500	661.2625	660.0330	110
288 - 294	35	289.2625	289.2625	288.0144	48	666 - 672	103	667.2500	667.2625	666.0333	111
294 - 300	36	295.2625	295.2625	294.0147	49	672 - 678	104	673.2500	673.2625	672.0336	112
300 - 306	37	301.2625	301.2625	300.0150	50	678 - 684	105	679.2500	679.2625	678.0339	113
306 - 312	38	307.2625	307.2625	306.0153	51	684 - 690	106	685.2500	685.2625	684.0342	114
312 - 318	39	313.2625	313.2625	312.0156	52	690 - 696	107	691.2500	691.2625	690.0345	115
318 - 324	40	319.2625	319.2625	318.0159	53	696 - 702	108	697.2500	697.2625	696.0348	116
324 - 330	41	325.2625	325.2625	324.0162	54	702 - 708	109	703.2500	703.2625	702.0351	117
330 - 336	42	331.2750	330.0165		55	708 - 714	110	709.2500	709.2625	708.0354	118
336 - 342	43	337.2625	337.2625	336.0168	56	714 - 720	111	715.2500	715.2625	714.0357	119
342 - 348	44	343.2625	343.2625	342.0171	57	720 - 726	112	721.2500	721.2625	720.0360	120
348 - 354	45	349.2625	349.2625	348.0174	58	726 - 732	113	727.2500	727.2625	726.0363	121
354 - 360	46	355.2625	355.2625	354.0177	59	732 - 738	114	733.2500	733.2625	732.0366	122
360 - 366	47	361.2625	361.2625	360.0180	60	738 - 744	115	739.2500	739.2625	738.0369	123
366 - 372	48	367.2625	367.2625	366.0183	61	744 - 750	116	745.2500	745.2625	744.0372	124
372 - 378	49	373.2625	373.2625	372.0186	62	750 - 756	117	751.2500	751.2625	750.0375	125
378 - 384	50	379.2625	379.2625	378.0189	63	756 - 762	118	757.2500	757.2625	756.0378	126
384 - 390	51	385.2625	385.2625	384.0192	64	762 - 768	119	763.2500	763.2625	762.0381	127
390 - 396	52	391.2625	391.2625	390.0195	65	768 - 774	120	769.2500	769.2625	768.0384	128
396 - 402	53	397.2625	397.2625	396.0198	66	774 - 780	121	775.2500	775.2625	774.0387	129
402 - 408	54	403.2500	403.2625	402.0201	67	780 - 786	122	781.2500	781.2625	780.0390	130
408 - 414	55	409.2500	409.2625	408.0204	68	786 - 792	123	787.2500	787.2625	786.0393	131
414 - 420	56	415.2500	415.2625	414.0207	69	792 - 798	124	793.2500	793.2625	792.0396	132
420 - 426	57	421.2500	421.2625	420.0210	70	798 - 804	125	799.2500	799.2625	798.0399	133
426 - 432	58	427.2500	427.2625	426.0213	71						

This chart specifies the three common cable television frequency plans used in the United States: standard, IRC, and HRC. Column headings are:

• **NOMINAL CHANNEL BOUNDARIES** - The channel boundaries, in MHz, of the "standard" channels. Many IRC and HRC channels use slightly different boundaries.

• **EIA CABLE CHANNEL** - The number assigned to this cable channel by EIA standard IS-132.

• **STANDARD CARRIER FREQUENCY** - The frequency of the visual carrier in the "standard" frequency plan.

• **IRC CARRIER FREQUENCY** - The frequency of the visual carrier in the IRC frequency plan.

• **HRC CARRIER FREQUENCY** - The frequency of the visual carrier in the HRC frequency plan.

• **HARMONIC** - The harmonic of the master

oscillator used to generate the IRC and HRC frequencies.

In every case, the aural carrier is 4.5 MHz above the visual carrier.

Source: EIA Interim Standard IS-132: Cable Television Channel Identification Plan. Electronic Industries Association, Washington, DC, 1994. This standard is incorporated by reference into the FCC Rules at 47 CFR 76.605(a)(2).

Figure 2. United States Cable Television Channel Offset Frequencies

Broadband Networks Part Fifteen (continued)

In order for this technique to be effective, *all* visual carriers must be phaselocked to harmonics of the master oscillator. This requirement produces some interesting anomalies:

- All carriers must be offset +12.5 KHz, even if they do not overlap any FAA bands. Thus, for example, Channel 2 operates at 55.2625 MHz and Channel 7 operates 175.2625 MHz.
- Channels 5 and 6 must be shifted up by 2 MHz in order to fit into the incremental offset plan. Thus, Channel 5 operates at 79.2625 MHz and Channel 6 operates at 85.2625 MHz. The top of channel 6 extends to 90 MHz, overlapping the FM band by about 2 MHz.
- The gap between Channels 4 and 5 extends from 72 to 78 MHz, equal to one television channel. This channel is designated Channel 1 by the EIA cable television channel-numbering standard.
- The FM band extends from 90 to 108 MHz, equal to three television channels. These channels are designated 95, 96, and 97 by the EIA standard.
- Channels 42, 98, and 99 (which must be offset ±25 KHz under FCC offset rules) cannot be used without violating the incremental-offset plan. Cable operators have two choices: leave these channels vacant, or use them for non-video services which can be operated below the +38.75-dB threshold.

The IRC frequency-assignment plan is reproduced in Figure 2.

Virtually all cable-ready TV sets can accommodate this frequency plan, although some older sets cannot properly tune Channels 1, 5, 6, and 95-99. Newer cable-ready sets usually include a provision for IRC tuning: either a switch or an option in the setup menu. If the TV

set cannot tune to all IRC frequencies, a settop converter is usually required.

HRC: HARMONICALLY-RELATED CARRIERS

Although the IRC frequency plan masks third-order distortion, it does not mask second-order. As we noted last month, second-order is the dominant form of distortion in broadband networks carrying more than 12 channels, but less than about 30. Second-order is also dominant in networks using the IRC frequency plan: IRC simply masks the third-order distortions, allowing the second-order to become dominant.

Both second-order *and* third-order distortions can be masked through the use of a technique called "Harmonically Related Carriers", or HRC. Using this technique, all visual carriers are phaselocked to harmonics of a single master oscillator in accordance with the following relationship:

$$F(n) = F(o) * n$$

where F(o) is the frequency of the master oscillator and n is the harmonic.

For example, consider the combination of Channels 29 and 30, assuming that F(o) = 6 MHz. These visual carriers are phaselocked to the 42nd and 43rd harmonics, as follows:

$$F(29) = 6 * 42 = 252 \text{ MHz.}$$

$$F(30) = 6 * 43 = 258 \text{ MHz.}$$

One (of several) second-order distortion products generated by this combination of carriers is:

$$252 + 258 = 510 \text{ MHz}$$

which falls at the Channel 72 visual carrier. Assuming that the Channel 72 visual carrier is also phaselocked to the

same master oscillator, the distortion product falls precisely on top of the visual carrier, effectively masking it.

Like IRC, this technique doesn't actually reduce distortion; it simply masks it by aligning it precisely on top of other visual carriers.

In order for this technique to be effective, all visual carriers must be phaselocked to harmonics of the same master oscillator. This requirement makes it impossible to apply the offsets specified in the FCC rules. To illustrate this, consider what would happen if we attempted to apply the FCC offsets to the carriers used in our previous example:

$$252.0125 + 258.0125 = 510.025 \text{ MHz.}$$

The offset Channel 72 visual carrier is at 510.0125 MHz, so this distortion product clearly does not fall on top of it.


To accommodate this situation, the FCC has established a special rule for HRC systems: the master oscillator must operate at a frequency F(o) of 6.0003 MHz ± 1 Hz. Note that frequency tolerance: plus-or-minus one Hertz. The FAA has accepted this rule with the understanding that this extremely tight frequency tolerance ensures that no visual carrier will ever conflict with any Aeronautical Mobile or ILS frequency.

Satisfying this tolerance specification usually requires the use of a rubidium-controlled frequency standard.

Offsets resulting from this plan are:

- Aeronautical Mobile: Depending on the frequency, the offset varies from 5.2 to 12.5 KHz. The FAA has accepted these offsets as sufficient to protect communications in these bands.

(continued on next page)



<http://www.CTIinfo.com>
 email - cti@CTIinfo.com
 Phone - 608-831-4636
 Fax - 608-836-1840
 VCR Controllers
 Character Generators
 Satellite Antenna Controllers
 Broadcast / Cable Television Consulting



Custom micro controller logic in 2 days.
 RS-422: VTR Controller, Record Timer
 Time: News Timer Plus, Net VITC, WWV Reference
 Video Overlay (large time of day)
 CODI C.G.: Custom utilities for PC's
<http://members.aol.com/sloop26/maneylog.htm>
 608-277-8001 sloop26@aol.com



JAMES F. DOHERTY
 Traffic Supervisor
 Satellite & Video Services
Norlight™
 TELECOMMUNICATIONS
 275 NORTH CORPORATE DRIVE
 BROOKFIELD, WI 53045-5818
 414.792.7708 FAX: 414.792.7717
 e-mail: jfd@norlight.com

Broadband Networks Part Fifteen (conclusion)

- ILS: The Channel 42 visual carrier operates at 330.0165 MHz, offset +16.5 KHz from the nearest ILS frequency (330.0000 MHz). The FAA has accepted this as sufficient offset to ensure safe operation of its ILS transmitters.

- VOR: Visual carriers in Channels 98 and 99 are offset less than 6 KHz from VOR frequencies. The FAA has not accepted these offsets as sufficient; accordingly, these channels cannot be used for NTSC video signals. Cable operators have two choices: leave these channels vacant, or use them for non-video services which can be operated below the +38.75-dB threshold.

This frequency plan produces the following anomalies:

- All visual carriers fall at harmonics of 6.0003 MHz. Thus, all channel boundaries are shifted down approximately 1.25 MHz, except for Channels 5 and 6 which are shifted up about 0.75 MHz. The top of channel 6 extends to 88.75 MHz.
- The gap between Channels 4 and 5 extends from 70.75 to 76.75 MHz, equal to one television channel, designated Channel 1.
- The FM band extends from 88.75 to 106.75 MHz, equal to three television channels, designated 95, 96, and 97.

The HRC frequency spectrum is reproduced in Figure 2.

Many, but certainly not all, cable-ready TV sets can accommodate this frequency plan. Compatible sets include a provision for tuning HRC channels: either a switch or an option in the setup menu. If the TV set cannot tune to HRC frequencies, a settop converter is usually required.

CONCLUSION

IRC and HRC systems were first introduced in the late 70s. During this period, many new cable television systems were being designed to carry 50 or 60 channels; IRC and HRC were the only feasible means of controlling distortion.

However, as we have noted in earlier articles, the best way to control distortion (and solve a multitude of other problems as well) is to keep amplifier cascades as short as possible. AML microwave was a step in that direction: it allowed us to build cable systems covering large geographic areas with cascades limited to only 15 to 20 amplifiers.

In the past decade, the rise of fiber optics has improved the situation by an order of magnitude. It's now possible to build broadband networks covering vast geographic areas with cascades limited to just one or two amplifiers. Indeed, Southern New England Telephone Company (SNET) recently began construction of a broadband network covering the entire state of Connecticut.

Fiber-based networks also allow a return to the "standard" frequency plan; IRC and HRC techniques are no longer necessary. Virtually all cable TV systems built (or rebuilt) within the past dozen years use now the standard frequency plan.

Thanks to fiber optics, IRC and HRC are now nothing more than interesting historical relics.

Next month, we'll take up a new subject: amplifier powering.

CORRECTION: In Part 8 (November 1996) of this series, I stated that "second-

order distortion is dominant in systems carrying a limited number of channels, usually no more than a dozen; cross-modulation is dominant in systems carrying up to about 30 channels." This is obviously incorrect. Cross-modulation distortion is dominant in systems carrying up to 12 channels; second-order is dominant in systems carrying more than 12, up to about 30 channels.

FCC DEALS WITH DEFAULTS

By Tom Smith

The FCC, faced with a number of the PCS C-block auction winners seeking bankruptcy protection from the FCC for their license payments, adopted a number of payment options for the winning bidders. The vote was 3-1 with Chairman Reed Hundt voting against. Mr. Hundt felt the options were too harsh.

Many of the bidders now feel that they can not afford to pay the amount they bid and sought lower payments. The total bids for the PCS C-group was \$10.2 billion, but the Congressional Budget Office figures the FCC will collect only \$3-5 billion.

The options that the FCC adopted are, full payment with a one year grace period, return the licenses with a 10% bid forfeit, return half the frequencies and pay half the bid, or take 70% of their downpayment and buy as many licenses they could afford upfront.

Some companies felt the options were fair and some say they will still have to file for bankruptcy.

(From NY TIMES and THE WALL STREET JOURNAL)



Milwaukee
Madison
Chicago
Indianapolis

VIDEO I M A G E S

Bob Marek
Account Executive

Video Images, Inc.
2137 S. Stoughton Road • Madison, WI 53716
Phone: (608) 221-8888 • FAX: (608) 221-9252
Internet: <http://www.videoimages.com/>

James (Jim) B. Rogers 

Western Regional Sales Manager
(619) 748-2151
Fax: (619) 748-1879
Pager: (800) 970-3239
E-mail: jrogers@comarkcom.com
JBRCOM@worldnet.att.net


a THOMCAST Company

12612 Arabian Way • Poway, CA 92064 U.S.A.
<http://www.comarkcom.com>



NIALL ENTERPRISES

P.O. Box 314
Belmont, Wisconsin 53510
(608) 762-5327 John O'Neill

Emergency Alert System Firsthand

Compiled by Paul Stoffel

See the SBE National webpages for "FCC RELEASES SECOND EAS REPORT AND ORDER" (updated October '97) under the SBE EAS COMMITTEE REPORT.

- Dane County Emergency Management distributes an "Emergency Distribution List" via e-mail. To subscribe to the list server use address: <maiser@dc-ems.co.dane.wi.us>. In text, type: SUBSCRIBE POWER. The list server will be used for transmission of urgent messages concerning life safety threats, not general messages. The following categories are examples of the type of message that you may receive on this list server: severe weather events, like thunderstorm, tornado, flash flood and blizzard warnings; electrical power interruption notifications; and hazardous materials releases. This new warning tool doesn't replace any of the existing warning systems, but is rather just an additional avenue for dissemination of warnings to employees at their work sites. This system will be tested between 11:00 am and 1:00 pm on the first Wednesday of every month. For more information about warning alternatives for the citizens of Dane County, access the Dane County Emergency Management web site at: <<http://www.co.dane.wi.us/ems/ems.html>>.

- The Radio Shack EAS-compatible weather radio is in the stores now. The part number will be 12-249, priced just under \$80.00. According to Gary Timm, "The first digit of the 6-digit FIPS should be entered as 0 (zero) for entire county. Then, the 5-digit number shown for your county." For example, "055025" for Dane County, Wisconsin. Other features: an external antenna input in addition to the built-in rod antenna; external alarm terminals with 7.5 Vdc output; desk or wall-mounted.

The LCD text message does not scroll, and the warning level is not selectable. Rather, when a message is sent, the type of message is displayed in the LCD window and the appropriate light lights. So if a Tornado Warning were issued, the radio the display would read "TORNADO" and the "Warning" LED would be lit.

- This past August, I installed the 40-second non-volatile audio option (two ICs) in an Endec. The NVaudio stores the State EAS Plan's recommended script for when the need arises to originate an RMT. The programming capabilities of the Endec allow the user to pre-program an RMT template that specifies the "AUDIO" source to be "NVaudio." The operator simply presses the RMT button on the handheld remote control (or can call up the RMT template on the front panel menu) and the RMT is sent out automatically (header codes, attention signal, NVaudio, EOM codes). The operator can quickly originate an RMT should any received RMT not relay. Or the operator can originate an RMT should the FCC inspector ask. (The NVaudio will last as long as the internal lithium battery does. An audio cart is available should the Endec die.)

The RMT script lasts for approx. 12 seconds. So the 10-second NVaudio option wasn't long enough. The parameter file's INTERNAL.NV.STORED.LENGTH was set to 1200 (1200 x "10 msec increments" = 12 seconds). The audio was recorded with the MENU.ALERT.RECORD.NVAUDIO menu choice.

CONGRESS QUESTIONS TV EXECUTIVES ON DTV

By Tom Smith

After comments by Preston Padden, President of ABC-TV Network, and David Sinclair of Sinclair Broadcast Group, that they would use DTV for multicasting instead of HDTV, the Senate Commerce Committee held a hearing to seek information on broadcaster's plans for the spectrum.

In testimony before the committee, the broadcast execs gave the committee their plans for DTV. They stated that HDTV was in their plans, but said that depending on marketplace demands, multicasting was not being ruled out for part of the broadcast day. Some members of Congress want the broadcasters to use DTV for high definition only, saying that's why they were given the spectrum in the first place.

(From BROADCASTING and CABLE and THE WALL STREET JOURNAL)

LOCAL BROADCAST CHANNEL BLOCKAGE DURING EAS

*By Leonard Charles
SBE EAS Committee Chair*

With the FCC release of the second EAS Report and Order, there is a renewed concern by Television broadcasters over cable system blockage of their channel during EAS alerts and tests. Despite comments making a strong case against such blockage under any circumstances, the Commission continues to allow it. The strongest plea came from the NAB which "...is primarily concerned because providing emergency information is a key component of most broadcast stations, and cable television operators may not provide emergency information that is as useful to the viewer during an emergency as broadcasters provide." The NAB is also concerned that the cable interruption may come at the same time as more detailed information is being broadcast by the local TV station.

Though the FCC did not prevent local TV station channel interruption, they did make provisions for agreements between broadcasters and cable systems to prevent such blockage. Paragraph 11.51(g)(4) states: "Cable systems and wireless cable systems may elect not to interrupt EAS messages from broadcast stations based upon a written agreement between all concerned. Further, cable systems and wireless cable systems may elect not to interrupt the programming of a broadcast station carrying news or weather related emergency information with state and local EAS messages based on a written agreement between all parties."

In addition, the FCC said they will promptly issue a Further Notice of Proposed Rulemaking focused on whether the Commission's rules are adequate to permit broadcasters to provide their audiences with important local emergency information without interruption by EAS messages provided by cable systems.

For more information, see paragraphs 34 and 35 in the Second EAS Report and Order at <<http://www.fcc.gov/cib/eas/document.htm>> or go to the SBE web site at <<http://www.sbe.org>> and click on the EAS Committee banner.

THE CHAPTER 24 DOMAIN

By Leonard Charles

SBE Chapter 24 has taken its home site to the next level. Thanks to the folks at broadcast.net, Chapter 24 has had its own home page for a number of years. Using their guidance to grow upon, the Chapter has now secured its own Domain Name registration under the name "sbe24.org". In addition, the Chapters home site has been relocated to the WISC-TV internet server in Madison. The only change you will notice is the address. It is now "http://www.sbe24.org" on the World Wide Web.

If you had any browser bookmarks to specific pages on our broadcast.net site, you will need to re-establish them with our new address as part of the bookmarked URL. Broadcast.net will continue to list Chapter 24 in their "Chapters on the Web" listing and direct any browsers choosing it to the new Madison home. Broadcast.net will also continue to manage the Chapter 24 email list server. The domain name move is designed as educational for those Chapter members directly involved with the site, and to make content housekeeping a bit easier.

WMSN Tower Removed (continued)

Candelabra's guys - and not let anything float its way into the Candelabra tower. They took the tower down section by section, with the old transmission line still attached to the sections. Then on the ground, they dismantled the sections for transport to New York. It should be re-erected in the spring for a client of SST Inc.

CABLE TV EAS MANDATES

By Leonard Charles
SBE EAS Committee Chair

The FCC has released its second EAS Report and Order to clarify cable participation. It specifies cable system mandates and implementation timetables which are to be based on number of subscribers.

All wired cable systems will participate according to the following schedule:

1. Systems that serve 10,000 or more subscribers shall install EAS equipment and provide EAS audio and video messages on all channels by December 31, 1998.
2. Systems that serve 5,000 or more, but fewer than 10,000 subscribers shall install EAS equipment and provide EAS audio and video messages on all channels by October 1, 2002.
3. Systems that serve fewer than 5,000 subscribers shall either provide National level EAS messages on all programmed channels (including the required EAS test messages), or install EAS equipment and provide a video interrupt and audio alert message on all programmed channels and EAS audio and video messages on at least one programmed channel by October 1, 2002.

The FCC is requiring wireless cable systems to participate in EAS on the same basis as wired cable systems but they declined to require Satellite Master Antenna Television (SMATV), Open Video Systems (OVS), and cellular and wired telephone services to participate.

The Commission stated that the requirements of existing local franchise agreements for special warning systems will not be preempted by the EAS so long as they do not conflict with the EAS requirements.

More information is available on the SBE web site at www.sbe.org by clicking on the EAS Committee banner.

JOB OPPORTUNITY

TELEVISION EDITING TECHNICIAN AT WHA-TV

JOB DUTIES: Electronically edit field or in-house video from various sources into complete programs, either independently or with a producer assisting. Additional tasks will include the operation of videotape machines, cameras, and audio mixing equipment along with the installation, maintenance, and repair of television production equipment.

KNOWLEDGE REQUIRED: At least two years experience operating CMX Omni-1000 or equivalent editing equipment. Must have intimate understanding of operation of waveform monitors, vectorscopes, VU meters, and stereo phase monitors. Must possess sufficient knowledge of the setup and operation of Ampex VPR-80, Sony BVW-75, and Panasonic D-3 videotape machines to permit independent editing. Working knowledge of industry standards and FCC regulations. Ability to perform basic technical maintenance and equipment repair. Experience with Avid non-linear editing systems desired. FCC General Class License and Society of Broadcast Engineers (SBE) Certification preferred. Schedule will include evenings and weekends.

To request special application/examination materials, call or write to Sandra Baker; UW-Extension; Classified Personnel Office; 432 North Lake Street, Room 109; Madison, WI 53706; (608) 262-9475. Completed application/examination materials must be received by 4:30 p.m., 5 NOV 97. The best qualified candidates will be invited to participate in the next step of the selection process. This classification is included in the Technical Bargaining Unit. A six-month probationary period is required.

 HARRIS Tom Harle DISTRICT SALES MANAGER RADIO	HARRIS CORPORATION BROADCAST DIVISION District Sales Office: 1913 Fairoak Road Naperville, IL 60605
	TEL: 708-420-8899 FAX: 708-420-9171
	e-mail: tharle@harris.com Sales: 800-622-0022
	(612) 896-9898 FAX (612) 896-9899
	

David Thormodsgaard Broadcast Sales Engineer thor@alphavideo.com Pager#(800) 236-0034 Pin 12462 (800) 388-0008 7711 Computer Avenue Edina, MN 55435 (612) 896-9898 FAX (612) 896-9899	
---	--





FCC Rulemakings

Compiled by Tom Smith

FINAL RULES

**ET Docket No. 93-62; FCC 97-303
Guidelines for Evaluating the
Environmental Effects of
Radiofrequency Radiation**

The FCC has issued new guidelines and methods for the evaluation of the environmental effects of radio frequency radiation produced by FCC regulated transmitters. This is a Second Memorandum Opinion and Order on this subject. The FCC hopes that this action will refine and clarify decisions in the first Report and Order.

This action contains a listing of all FCC licensed services that are subject to routine RF environmental evaluation. This includes broadcast (part 73-74), PCS (part 24), cellular, paging, and radiotelephone (part 22), MMDS and LMDS (wireless cable, part 21 & 101), private two-way and paging (part 90), satellite (part 25), wireless communications services (parts 26-27), maritime (part 80), Experimental (part 5) and amateur (part 73).

There is a list of minimum antenna heights and power levels that require routine environmental evaluation. For broadcasters, all broadcast transmitters are included, auxiliaries need to meet a minimum power and height limit. With amateur stations, the power limits vary according to frequency. The FCC also eased the rules for small transmitters in multi-transmitter sites. Transmitter plants producing 5% or more of the combined power density exposure limits are required to share the responsibility for correcting levels outside the exposure limits.

This notice was published in the FEDERAL REGISTER on September 12,

1997 on pages 47,960-47,968 with a correction published on September 22 on page 49,557. This action was adopted and released on August 25, 1997 and becomes effective on October 15, 1997.

**MM Docket No. 95-176; FCC 97-279
Closed Captioning of Video
Programming**

This ruling by the FCC is to implement section 713 of the Communications Act of 1934 as amended by section 305 of the Telecommunications Act of 1996. This ruling requires program suppliers that are regulated by the FCC to close caption most, if not all, of their video programming. Those subject to the rules include broadcasters, cable and wireless cable systems, and their program suppliers.

This action sets deadlines for meeting percentage of programs captioned, exemptions for some types of programs and for small program suppliers where cost would be an undue burden.

By January 1, 2006, 95% of all TV programming is to be captioned with lesser requirements starting January 1, 2000 and increasing in steps till January 1, 2006.

This action was adopted on August 7, 1997 and released on August 22, 1997. It becomes effective on January 1, 1998 and was published in the FEDERAL REGISTER on September 16, 1997 on pages 48,487-48,496.

**MM Docket No. 96-58; FCC 97-290
Certain Minor Changes in Broadcast
Facilities Without A Construction
Permit**

The FCC has amended it's rules to allow certain modifications to a station's transmission facilities without first obtaining a construction permit. A station would

only have to file an modification of license application after completing the modifications. The modifications that would only require one step applications include: the replacement of an antenna with an identical or similar antenna (same number of bays), adding vertical polarization signal up to same ERP as horizontal signal, use of former main transmitter site as an auxiliary (backup), and FM station power reduction (while maintaining required signal over city of license) or power increase up to maximum allowed for station's class of operation. Replacement of some directional antennas are covered by the one step application.

Construction permits are still required for sites near AM towers, change of tower coordinates or height, directional antennas not covered under one step applications, and power changes to meet ownership requirements. Moving a main studio outside of the city of license still requires an application before the move.

This action created a large number of rule changes, and stations should check the rules before making any changes without a construction permit. Some modifications may be covered under a one step application and a similar modification may still need a construction permit.

These rules were adopted on August 14, 1997 and released on August 22, 1997. The rules become effective on December 1, 1997 and were published in the FEDERAL REGISTER on September 30, 1997 on pages 51,052-51,063.

**MM Docket No. 96-120; FCC 97-276
Grandfathered Short-spaced FM
Stations**

The FCC has relaxed some of it's rules concerning grandfathered short-spaced stations, which will allow these stations to increase power or make changes in transmitter location with greater ease. There are about 450 stations that were

(continued on next page)


SCHARCH ELECTRONICS CO.
Small Business Communications
1105 Middleton Street
MADISON, WI 53717-1078
(608) 831-2266 (800) 831-2266



FUJI PHOTO FILM U.S.A., INC.
1285 Hamilton Parkway
Itasca, IL 60143
630-773-7200 Ext. 7293 • 800-877-0555 Ext. 7293
Fax 630-773-6266 • Fuji Voice Mail 800-736-3600 Ext. 7293

**MAGNETIC MARKETS DIVISION
PROFESSIONAL PRODUCTS GROUP**

Jerry Van Vliet
Account Representative



**WKOW
Madison**

5727 Tokay Boulevard
Madison, Wisconsin 53719
(608) 274-1234
Fax: (608) 274-9514

built before the 1964 transmitter separation requirements were created, and do not meet those standards. Because these stations are shortspace to other stations, it has been difficult for these stations to make changes to their transmitter facilities. These rule changes may aid some of these stations to make needed changes to meet changing market conditions.

These rules became effective on November 25, 1997 and were adopted on August 4, 1997 and released on August 8, 1997. They were published in the FEDERAL REGISTER on September 26, 1997 on pages 50,518-50,522.

PROPOSED RULE

**ET Docket No. 97-206; FCC 97-340
Technical Requirements to Enable
Blocking of Video Programming
Based on Program Ratings**

The FCC has released in the FEDERAL REGISTER a summary of the notice of rulemaking to begin the process to require the manufactures of all TV sets and PCs with screens of 13" and over to be able to block programs from a signal on TV line 21, to be based on the TV rating system. This is the so-called V-CHIP. The proposed rules would set technical standards and would ensure that broadcast, low-power and translator stations, and cable systems would carry these signals. The FCC also proposes that MDS (wireless cable) and Direct Broadcast Satellite (DBS) be required to carry these signals.

The full text of this notice is available from the FCC's printer.

Comments are due on November 24, 1997 and replies are due on December 8, 1997. This notice was adopted on September 25, 1997 and released on September 27, 1997. Published in the FEDERAL REGISTER on October 9, 1997 on pages 52,677-52,679

Compiled from the FEDERAL REGISTER
(www.access.gpo.gov)

Steve Olson Tektronix, Inc.
Account Manager **Video and Networking Division**
515 West Algonquin Road
Arlington Heights, Illinois 60005
E Mail: stephen.olson@tek.com
503 305-8488 Voice Mail
414 425-8050 Office
847 734-6789 414 425-8537 Fax
847 364-7582 Fax

P

 **LOCAL LEGALS**

By Tom Smith

PROPOSED

**WMJB(FM) Evansville, WI. 105.9
Mhz at 1.4 kw, antenna at 493 ft.**

Thomas and Barbara Kwiatowski, Lake Geneva, WI. seeks FCC permission to purchase WMJB from Seehafer Broadcasting Corp. (Don Seehafer, Pres.) for \$1.5 million.

The Kwiatowski's also own WLKG(FM) in Lake Geneva. Seehafer Broadcasting Corp. owns WOMT(AM)-WQTC(FM) in Manitowoc, WI. and WXCO(AM)-WYCO(FM) in Wausau, WI.


**WBEV(AM)-WXRO(FM) Beaver
Dam, WI. and WYKY(FM)
Columbus, WI.**

Good Karma Broadcasting LLC, North Brunswick, NJ (Craig Karmazin) seeks approval to purchase WBEV, WXRO and WYKY from Beaver Dam Broadcasting Co. Inc. (Joseph E. McNoughton) for \$3.8 million.

The Joseph E. McNoughton Trust owns WRMN(AM)-WJKL(FM) Elgin, WBIG(AM) Aurora, WCRA(AM)-WCRC(FM) Effingham, all in Illinois and WSHP(AM) in North Las Vegas, NV. Good Karma Broadcasting has no other broadcast interests.

WBEV operates at 1430 khz with 1 kw, WXRO is at 95.3 mhz with 6 kw at 328 ft. and WYKY is at 100.5 mhz with 6 kw at 328 ft.

Compiled from BROADCASTING
and CABLE


SKY LINE
COMMUNICATIONS, LTD. - MADISON, WI
ANTENNA SPECIALISTS - TOWER Erectors

1965 West Ridge Rd.
P.O. Box 51
Cottage Grove, WI 53527
608 / 839-4075
FAX: 608 / 839-4985

RICHARD H. WOOD
President TOWERS • ANTENNAS
CONSTRUCTION • MAINTENANCE

**CHAPTER 24
SUSTAINING
MEMBERS**

RECENT RENEWALS:

Comark Communications
Niall Enterprises

**THANKS TO ALL OUR
SUSTAINING MEMBERS:**

Alpha Video
BCS Wireless
CTI
Clark Wire and Cable
Fuji Film
Harris Corporation
Hewlett-Packard
Louth Automation
maney-logic
Norlight Telecommunications
Panasonic Broadcast
Richardson Electronics
Roscor Wisconsin
Sarch Electronics
Skyline Communications
Sony Broadcast
Tektronix
Teleport Minnesota
Video Images
WISC-TV 3
WKOW-TV 27
WMSN-TV 47
WMTV-TV 15


NBC 15
WMTV • MADISON

PHONE 608-274-1515
FAX 608-271-5193

615 FORWARD DRIVE
MADISON, WI 53711 **WORKING FOR YOU!**
www.nbc15.com feedback@nbc15.com

SONY **Kevin Peckham**
Account Manager
Broadcast Products Division

Sony Communications Products Company
1200 North Arlington Heights Road
Itasca, Illinois 60143
Telephone (608) 271-3778
(708) 773-6046

Service Center (708) 773-6037
Emer. Tech. Assist. (201) 833-9533
National Parts Center (800) 538-7550

SBE NATIONAL



Society of Broadcast Engineers, Inc.
8445 Keystone Crossing
Suite 140
Indianapolis, IN 46240



Office (317) 253-1640
Fax (317) 253-0418
Job Line (317) 253-0474
<http://www.sbe.org>



Mark Durenberger
General Manager
Office (612) 330-2433
Fax (612) 330-2603
e-mail
durenberger@teleportmn.com

90 South 11th Street
Minneapolis, MN
55403



Jon S. Gedymin

Video Sales Manager
Midwest Region

Hewlett-Packard Company
250 North Patrick Boulevard, Suite 100
Brookfield, Wisconsin 53045-9945

800/477-6111 Ext. 2263
Fax 414/569-0966

Internet jon_gedymin@hp.com



Becky Hilborn
Broadcast Sales
Specialist

40W267 Keslinger Road
LaFox, IL 60147 USA

Your Tube and
Broadcast Component
Source.

Phone: (800) 348-5580
(630) 208-2372
FAX: (630) 208-2450
email: becky@rell.com
WWW: <http://www.rell.com>



Broadcast & Television Systems Company



Atlanta 1996
The Official Broadcast
Equipment of the
1996 Olympic Games.

HERB VANDRIEL
Direct Sales Manager
Entertainment Systems Division

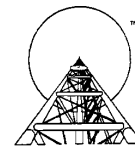
1707 N Randall Road
E-Zip: 1-C-3 Elgin, IL 61023
WI Tel: 608.355.0662
WI FAX: 608.355.0663
HQ Tel: 847.468.5160
HQ Fax: 847.468.5161

Division of Matsushita Electric Corporation of America



A SULLIVAN BROADCASTING STATION

7847 BIG SKY DRIVE
MADISON, WISCONSIN 53719
(608)833-0047 • FAX (608)833-5055



John W. Crooks
Site Installation Manager

608-527-5670 ph.
P.O. Box 730
New Glarus, WI 53574-0730
johnc@bcswireless.com
fax: 608-527-5674

SBE

SBE Chapter 24 Newsletter
84 Goldenrod Lane #6
Madison, WI 53719-3230

FIRST CLASS MAIL

Newsletter edited on Pagemaker 5.0 by: Mike Norton

Contributors this month: Leonard Charles, Neal McLain, Matt Mommaerts, Kevin Ruppert, Tom Smith, Paul Stoffel, and Tom Weeden. Thanks to Chris Cain for his work on the Chapter 24 WWW page.

© 1997 by SBE Chapter 24. Views expressed herein do not necessarily reflect the official positions of the Society, its officers, or its members. SBE Chapter 24 regrets, but is not liable for, any omissions or errors. The Chapter 24 Newsletter is published twelve times per year. Other SBE Chapters are permitted to use excerpts if attributed to the original author, sources, and SBE Chapter 24.