VCARA

CONNECTION

Vermilion County Amateur Radio Association

April 2010

Hams To Help Offset Health Care Plan

Buried in the middle of the 1200-page Health Care Reform package is something that should be disturbing to all US amateur radio operators. Embedded in the funding guidelines section 415, paragraph 27, line 45, are details on one of the mechanisms that the government intends to employ to help pay for the staggering costs of the new plan.

To put it simply, the new health care guidelines support the notion of creative funding from untapped resources, and from other government agencies, like the FCC. This puts the burden on funding on other agencies, and therefore the health care reform pundits can claim that "they" didn't introduce any new taxes to pay for everything.

Lurking in the depths of the new health care package is a time bomb waiting to affect all US Amateur Radio Operators; The new Talk And Pay (TAP) Tax.. What does the TAP Tax do? Well, just as it implies, it adds a tax on to each amateur license, based on usage of the bands.

The FCC knew it was going to be troublesome to enforce this kind of regulation, so they came up with a clever scheme – taxation by license class. All Technician, General, and Extra Class Licensees will be taxed at a different rate. Any holdover licenses from different classes will be taxed at the next higher rate, so novice license holders will be taxed as technicians, advanced holders as extra class licensees and so on. The logic is that higher class licenses can use more of the frequencies; therefore they pay a larger percentage. There are even paragraphs that define taxing stations that haven't operated, (although you have to prove that by filing a waiver), stations where the license holder has become a silent key (a different waiver), and repeater or space stations (when the license is held by a non-profit group, you can apply for a waiver as well). They legislators have even thought of the mechanism to capture revenue from youngsters, in their special Tax On Eventual Earnings (TOE) tax. So, a youngster who is not working will pay into a TOE TAP TAX account, in the form of a debit owed to the government. Even retirees do not escape this tax, as there is a provision for the SNAP TAP TAX (Sure Not Accounting for Productivity).

There does seem to be a provision for testing down to a previous license class, so you can get a tax break by forfeiting your current license class, (after taking a new 50 question written exam, and paying a hefty 45 dollar examination fee). You'll be then required to sign BCKTP in CW or "slash Back Tap" in voice.

This looks to be pretty well thought out. I stopped reading after seeing the FCC amateur radio entry. It appears that Cell phones and wireless data networks will be next. There are 20 other government agencies listed in the document. Where will this insanity end? All of this is scheduled to go into effect on April 1, 2011, because there apparently wasn't enough time to implement it before then.

If this doesn't negatively impact the growth of amateur radio, I don't know what will! I think it will also promote the notion of going really underground, and not using your callsign at all., actually a practice that I've already heard lots of people adopt, especially on VHF.

I called my congressman after reading all of this, and he said that there are already proposals being filed to allow credit for amateur radio operators involved in public service, and he called it the Support for Individuals Desiring to Engage in Services Training, Education, and Planning (SIDESTEP). That makes me feel a little better.

I think it just might be time to get rid of my gear, before all this TOE TAP, SNAP TAP, BACK TAP, and SIDESTEP stuff goes into affect. Once again, the government is here to help you.

April Fools!!!

Thanks to This from Jim, WB8AZP

Join us at
Lynch Volunteer Fire Dept
VCARA Club House
Woodbury Hill
Danville, Il
April 12, 2010

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Last Meeting's Minutes

President Josh Kittle, N9WEW convened the March 8th meeting at 1911 hours at the Lynch Volunteer Fire Department, located on 14th St., Danville, Il.

Treasurer's Report presented as follows:

Beginning Balance:	171.28
Expenses	
Ameren	42.36
Ending Balance:	128.92
Savings Acct Bal:	1041.94
Hamfest Acct. Bal:	1959.13
HF & Sav Total:	3001.07

Net Control Ops for Wednesday Night Nets until next meeting:
March 10th Dave KB9ZMF
March 17th Jim W9JUG
March 24th Quinten KA9LNJ
March 31st Tuck NF9T
April 7th Sven KC9NWX

Old Business:

4 new hams resulted from the last Technician class.

Equipment list for ARRL insurance still being compiled.

Possible Echolink connection being looked into by committee comprised of Jim W9JUG, Quinten KA9LNJ, Josh N9WEW, and Jim KB9AZA.

New Business:

AFMAD to be held on May 29th. Contact Dave KB9ZMF or Tom NU9R for more information.

Field Day locations were discussed. Dave KB9ZMF to scout out sites.

Setting up booths at local fairs was discussed, and Tuck NF9T to inquire about rates.

Picture CD is being compiled by Carline WD9EWU. Motion by Dave KB9ZMF to sell CD's at $5, with proceeds to go to General fund. Motion passed.

Meeting adjourned at 2040 hours.

Respectfully submitted,
Tuck Miller NF9T
Filling in for NU9R.

VCARA CONNECTION

The Vermilion County Amateur Radio Association (VCARA), a group of Amateur Radio operators, interested and active in the service of the Amateur Radio service, publish a monthly newsletter, where members and officers can post information of interest to other members.

Our policy is to print and/or post only information that is related to Amateur Radio, and not items of a political or religious nature, unless it has an impact on Amateur Radio, such as antenna ordinances, etc.

If a member wishes to have printed a topic that is not Amateur Radio related, they can submit a copy to the club newsletter editor, any club officer, and the matter will be discussed and decided upon by the Board of Directors.

No PERSONAL attacks will be allowed.

Submissions are due on the last Friday of each month!!

April Meeting Meeting
Monday April 12, 2010 7PM
VCARA Club House
Woodbury Hill
Danville, Il

For Sale!!!!

Radio Shack 2M FM radio (Unknown model)
Clegg 22ER 2M AM with a clegg mike

Contact Dave Cline for more info at kb9zmf@gmail.com

Your help is needed!!

The newsletter received a few contributions this month, and we thank you!! The more articles we receive, the better for the newsletter and for you, the reader!!

I would love to see people who can write an article each month..maybe on constructing small indoor antennas for 2 meters, making your own antennas for not only VHF frequencies, but HF frequencies as well. Maybe step by step directions on installing connectors. Believe it or not, there are probably some newbies who might not know.

Send me articles in Word or text if at all possible. I can not convert pdf files back to text. Sorry.

Help out your newsletter!!! Deadline is the last Friday of every month!! 73.

Amateur Radio…….

……..Not just a hobby, but a REAL service.

"READ THE DIRECTIONS"

Contributed by Jim 73, K9KUZ - Jim

Just before Christmas, my amplifier quit working. This was right after a city wide power outage. It had performed flawlessly for almost ten years. It's a Yaesu, and solid state. So, I did some research on the internet, and discovered several other hams with this very same problem, also right after a power failure. All of them pointed to blown components in the power supply, which on this amp is a separate unit weighing 40 pounds (the amp weighs 56 lbs.). Conveniently, most of the hams fixed the problems themselves and detailed exactly where the failed components were located on the chassis. Some even supplied photos of the fixes. But also a warning was evident, that being that there is no independent repair shop that will fix these amps. They have to be returned to the Yaesu service center in California. So, next step was to verify that, and I called AES in Milwaukee, where I bought it. Yes, indeed, only Yaesu can fix these things. Next, find the repair manual. Well, Yaesu does not publish their repair manuals, but I did find a pirated one on the internet. About 500 pages. I printed about 50. So, I called my son Jeff, the electrical engineer (and also KE9OD) who got his Extra ticket in Josh's class last year with me. Thanks Josh.

Jeff is very confident that we can fix this thing. Now, it is hard to describe this power supply box. It is held together with 100s, no 1000s, of screws. It took the two of us a solid 3 hours just to disassemble the covers and fans and a lot of cables inside. And, we still had not taken apart the two main p/s units inside....and their guts and boards and heat sinks etc .... so we saved that for another day, but we were able to check the first stage of resistors and found one open. So, order some. Then came that day. Fortunately, we did not have to disassemble everything, but the heat sinks did have to come out, along with some more cables. We checked the first 3 resistors in the A/C line. This is where most of the others had problems. Sure enough, resistor R-1 was the only one open. Why weren't the other 2 resistors with R-1, all in series, also blown ? Jeff replaced it, and we decided that perhaps this was the only problem. So back together it went. This was another whole day. I don't know how one person could possibly take this thing apart and put it back together with just two hands. Several hams on the net mentioned that they would never fix it again due to the labor involved. So the next step is to place it in the shack, cable the units together and hook up the 220, and power it on. Sounds simple, doesn't it? Well after both units are hooked up again, the p/s comes ON, the amp comes ON, runs thru it's diagnostics, everything looks OK. Then --- the amp's display says "ERROR 1005".

Now go back to the top of this story and read it's title. I should have done this. And done it again. So, Jeff and Jim give up. "ERROR 1005" is one of those that has several different meanings. I called Yaesu Tech Support the next day. They confirmed that this error message can mean many different things and I should return both units to them. Luckily, my grandson Derek (KC9CIT) has a FedEx employee discount and gets me a $97 discount in shipping, but it's still not cheap. Two weeks later I get a phone call, they want my credit card number to pursue repairs. A few more phone calls/emails occur. And then, while on my way back from Florida, I get a call from one of the techs: "Your amplifier has no problems, it works fine." We talked for ten minutes. I did not "read the directions". That is, the owners manual, which says that the power on function is performed by the transceiver !! OOPS. An expensive lesson.....so.....always "read the directions" (in my case, read the

Jim, W9JUG has contributed a file on Transmission Lines. The entire article can be found on the last 5 pages.

2010 Field Day

Friday June 25 Setup
Starts at 1pm Saturday June 26th
Ends at 1pm Sunday June 27th.
24 hours!!

VCARA will be operating at

Kickapoo State Park

Dale Clement [illegible]
10 March, 2008.

Transmission Lines

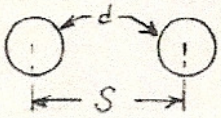
Characteristic Impedance: $Z_0 = \sqrt{L/C}$ L = Inductance, C = Capacitance per Unit Length.

Some Common Types

★ **BALANCED-CONDUCTOR LINE** — Open-Wire Line, Ladder Line, Window Line, Twisted-Pair Line, Twin-Lead, etc.

Balanced Currents in Conductors — Equal and Opposite.

END-VIEW



$Z_0 = 276 \log_{10}\left(\frac{2S}{d}\right)$, where:
- Z_0 = Characteristic Impedance.
- d = Conductor Diameter.
- S = Center-to-Center Spacing.

Any Dielectric (Insulation, Spacers, etc.) will Lower Z_0.

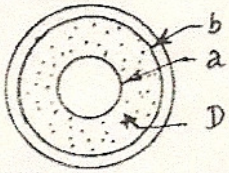
- Practical Values for Z_0 Range from 75Ω to 900Ω.

Balanced-Lines can have very low-Loss, but are affected by Weather (Moisture, Ice, Dirt), and Proximity to other Conductors.

★ **COAXIAL-CABLE** — Solid-Dielectric, Foam-Dielectric, Semi-Rigid, "Hard-Line", etc.

Unbalanced — Outer Conductor acts as a Shield.

END-VIEW



$Z_0 = \frac{138}{\sqrt{\epsilon_r}} \log_{10}\left(\frac{b}{a}\right)$, where:
- Z_0 = Characteristic Impedance.
- a = Outer-Diameter of Inner Conductor.
- b = Inner-Diameter of Outer Conductor.
- ϵ_r = Dielectric Constant. ("Relative Permittivity").

Coaxial-Cables can have higher Loss than Balanced-Lines, but are not affected by Weather and Proximity to other Conductors.

Practical values for Z_0 Range from 20Ω to 200Ω.

Minimum Attenuation occurs when $Z_0 \approx 75\Omega$, however, Maximum Power-Handling occurs when $Z_0 \approx 30\Omega$! } (50Ω is a good compromise for Amateur Radio!)

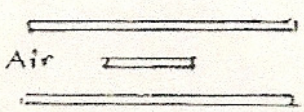
COMMON 50-Ω TYPES: RG-8 / RG-58 / 9913 / LMR-400.

COMMON 75-Ω TYPES: RG-11 / RG-59.

COMMON DIELECTRICS:
- Vacuum or Dry Air — (ϵ_r = 1.0, V.F. = 1.0).
- Foamed Polyethelene — (ϵ_r = 1.3 – 1.7, V.F. = 0.78 – 0.88).
- PTFE (Teflon®) — (ϵ_r = 2.1, V.F. = 0.69).
- Solid Polyethelene — (ϵ_r = 2.3, V.F. = 0.66).

"Velocity Factor" is Velocity of Signal in Cable Relative to Speed of Light. $V.F. = \frac{1}{\sqrt{\epsilon_r}}$

★ **STRIP-LINE**

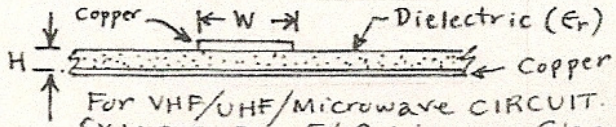


Flat Metal Strip Between Ground Planes.

For Power-Amplifiers, Filters, Tuners, etc.

★ **"MICRO-STRIPLINE"**

END-VIEW

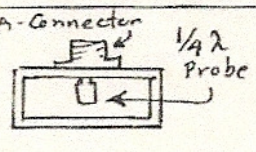


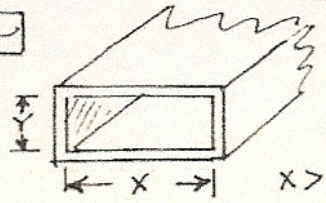
For VHF/UHF/Microwave CIRCUIT BOARDS.

EXAMPLE: For 50Ω Line on Glass-Epoxy Substrate (ϵ_r = 4.8), H = 1/16 in. (0.062 in), W = 0.105 in.

★ **WAVE-GUIDE**

END-VIEW





Useful for UHF & Microwaves

Very Low-Loss (Amateur us > 1GHz).

EXAMPLE: WR-90 (X = 0.90 in., Y = 0.40 in.)

Good for 8-12GHz. Loss @ 10GHz ≈ 3dB/100ft.

$X > \frac{1}{2}\lambda$ (X, Y are Inner Dimensions).

Dale F. Clement - AF1T

10 March, 2008.

TRANSMISSION-LINE LOSSES ~

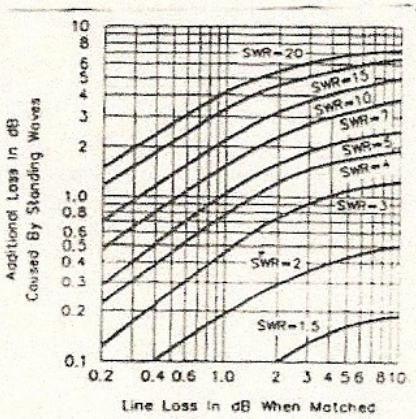
Attenuation is often rated in dB per 100 ft.

1.) **OHMIC LOSS** in Conductors. This increases with Frequency, since Electrons concentrate more on the Surface ("Skin Effect").

2.) **DIELECTRIC LOSS**. A Vacuum or Inert Gas is best, but in Practice the Conductors must be supported by some Insulating Material. Good Choices are PTFE (Teflon®), or Polyethelene (Solid or Foamed). This Loss may also increase with Frequency. Dielectric Constant (ϵ_r) will affect Characteristic Impedance (Z_0). Moisture will drastically increase Loss.

3.) **RADIATION LOSS**. Parallel-Conductor Line will Radiate if Currents are Unequal, or if Conductor Spacing is Large (> 1% λ). Coaxial-Cable will Radiate if the Shield has Holes or Gaps, or Connectors are not Tight. Also, Feeding a Balanced Antenna can result in Current Flow outside the Coaxial Shield – prevent this with a BALUN ("Balanced-to-Unbalanced" Transformer).

4.) **MISMATCH LOSS**. Reflected Power (High S.W.R.) causes Additional Loss over that when the Line is Matched (S.W.R. = 1). The Higher the Matched Loss is, the more Significant this Additional Loss becomes. For Long Runs of Coaxial-Cable at V.H.F. or U.H.F., the Load Impedance (R_L) of the Antenna should equal the Characteristic Impedance (Z_0) of the Cable. For Low-Loss Ladder-Line at H.F., a High S.W.R. may not matter much, as long as your Transmitter or Tuner can operate into the Load!



5.) **CONNECTOR LOSSES** result from Impedance Mismatches and Poor Interfaces (Moisture, Dirt, etc).

REDUCE LOSSES! ⟶ Increase Conductor-Size (Doubling Diameter ≈ Half the Loss). Shorten the Line (Move the Radio closer to the Antenna!). Keep Moisture and Corrosion away!

ESTIMATING LINE LOSS ⟶ If Loss in dB at one Frequency (f_1) is Known, then Loss in dB at another Frequency (f_2) ≈ dB at $f_1 \times \sqrt{f_2/f_1}$. (This may be optomistic, since it does not account for Change in Dielectric Loss with Frequency).

COAXIAL CONNECTORS ~ *Some Common Types.*

UHF Most Popular for H.F. – Can Handle 1.5 KW. Easy to Install, but not Waterproof. Good up to 200 MHz ("UHF" is a Misnomer!). Not Constant Impedance. Can be used with RG-8, RG-8X, RG-59, RG-58 Cables. Plug = PL-259; Jack = SO-239.

N Can Handle 1.5 KW at H.F. and V.H.F. ~ Constant Impedance. Good up to 12 GHz. Waterproof. Available in 50 Ω or 75 Ω Versions.

BNC Good for Test Equipment, Small or Portable Gear; for RG-58 Cable. Not Waterproof - Indoor Use only. Constant Impedance – Good to 1 or 2 GHz. Quick Disconnect (A Threaded Version, Type TNC, operates up to 12 GHz).

SMA (Sub-Miniature, Type A) ~ Most Popular Microwave Connector. Small – used with UT-141 Semi-Rigid or RG-58 Flexible Cables. Fragile ~ Difficult to Install. Good up to 18 GHz (Some Kinds up to 26 GHz). Found on some Miniature Portable Radios. Constant Impedance.

Dale J. Clement - AF1J
10 March, 2008.

TRANSMISSION-LINES AS CIRCUIT-COMPONENTS.

Transmission-Line Sections may be used instead of Discrete Components ("Lumped Elements") for 'Tuning', Phasing, or 'Matching' of Antennas, Feed-Lines, or Circuits.
Parallel-Conductor Line can be affected by nearby objects; Coaxial-Cables are Shielded and may be Coiled up without effect.

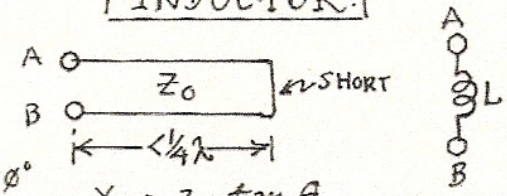
Assume Loss-Less Line.

X_L = Inductive Reactance (Ω) ; $X_L = 2\pi f L$, where L = Inductance (H.)
X_C = Capacitive Reactance (Ω) ; $X_C = \frac{1}{2\pi f C}$, where C = Capacitance (F.)
θ = Electrical Length, in Degrees.
Z_0 = Characteristic Impedance (Ω) of Transmission-Line.
Z_1 = Input Impedance (Ω).
Z_2 = Output Impedance (Ω).
f = Frequency (Hz.)

λ = Wave Length.
1λ corresponds to $\theta = 360°$

Note that Line-Lengths must include Velocity Factor (V.F.). Any Dielectric (Insulation) will slow down Velocity relative to the Speed of Light, and reduce the Wave-Length in the Line to less than that in Free Space. $V.F. = \frac{1}{\sqrt{\epsilon_r}}$, where ϵ_r is the Dielectric Constant of the Material. For a Vacuum or Dry Air, $\epsilon_r = 1.0$

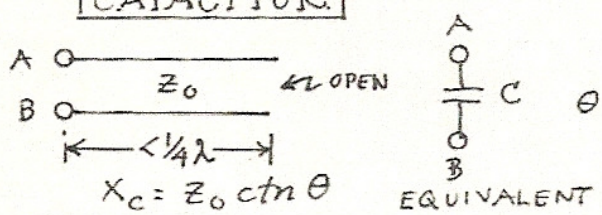
INDUCTOR.



$X_L = Z_0 \tan\theta$ EQUIVALENT

SPECIAL CASE:
For $1/8\lambda$, $\tan 45° = 1$, and $X_L = Z_0$

CAPACITOR.

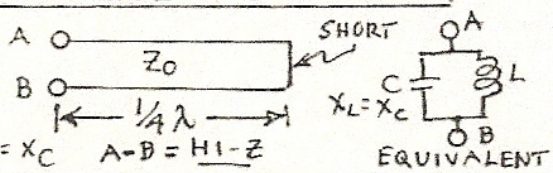


$\theta < 90°$

$X_C = Z_0 \operatorname{ctn}\theta$ EQUIVALENT

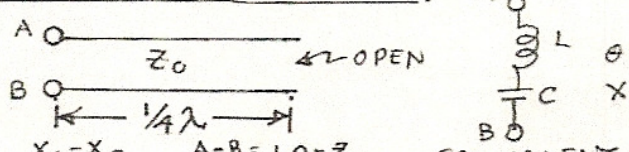
SPECIAL CASE:
For $1/8\lambda$, $\operatorname{ctn} 45° = 1$, and $X_C = Z_0$

PARALLEL RESONANCE.



$X_L = X_C$ A-B = HI-Z EQUIVALENT

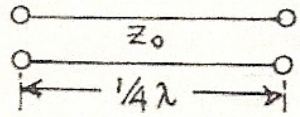
SERIES RESONANCE.



$\theta = 90°$ $X_L = X_C$

$X_L = X_C$ A-B = LO-Z. EQUIVALENT

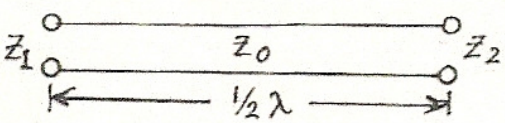
IMPEDANCE INVERTER.



$Z_1 = \frac{Z_0^2}{Z_2}$ OR $Z_0 = \sqrt{Z_1 Z_2}$

"λ TRANSFORMER"

"IMPEDANCE REPEATER."



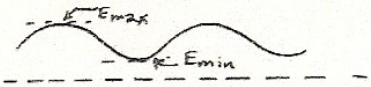
$Z_1 = Z_2$ Regardless of Z_0!

Dale F. Clement - AF1M
9 March, 2008.

MEASUREMENTS.

STANDING-WAVE RATIO

$$S.W.R. = \frac{E_{max}}{E_{min}}$$



Note: S.W.R. is always ≥ 1!

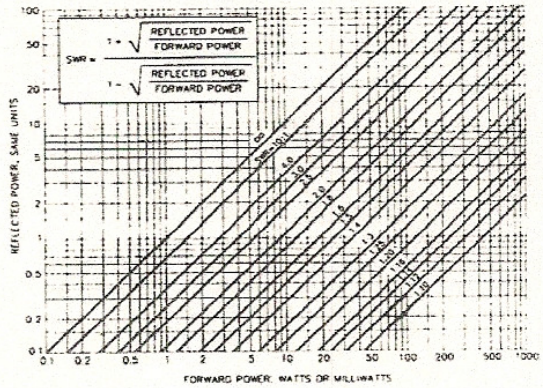
* For a Resistive Load (R_{LOAD}):

$$S.W.R = \frac{Z_0}{R_{LOAD}} \quad \text{or} \quad S.W.R. = \frac{R_{LOAD}}{Z_0},$$

whichever is > 1.

Z_0 = Characteristic Impedance of Transmission Line.

When $R_{LOAD} = Z_0$, the Line is Perfectly Matched.



S.W.R. VS FORWARD AND REFLECTED POWER.

RETURN-LOSS

This is much more accurate than S.W.R. for determining small changes in Mismatch.

$$R.L. = -20 \log_{10} |\rho|$$

$$\rho = \frac{E_r}{E_f} \Rightarrow |\rho| = \sqrt{\frac{P_r}{P_f}} = \frac{S.W.R. - 1}{S.W.R + 1}$$

Where:

R.L. = Return-Loss (in dB.)

ρ = Voltage Reflection Coefficient.

$|\rho|$ = Reflection Coefficient Magnitude.

E_r = Reflected Voltage.

E_f = Forward (Incident) Voltage.

P_r = Reflected Power.

P_f = Forward (Incident) Power.

R.L. (dB)	S.W.R.
0.0	∞
1.0	17.39
2.0	8.72
3.0	5.85
4.0	4.42
5.0	3.57
6.0	3.01
7.0	2.62
8.0	2.32
9.0	2.10
10.0	1.93
11.0	1.79
12.0	1.67
13.0	1.57
14.0	1.50
15.0	1.43
16.0	1.38
17.0	1.33
18.0	1.29

R.L. (dB)	S.W.R.
19.0	1.25
20.0	1.22
21.0	1.20
22.0	1.17
23.0	1.15
24.0	1.14
25.0	1.12
26.0	1.11
27.0	1.09
28.0	1.08
29.0	1.07
30.0	1.07
31.0	1.06
32.0	1.05
34.0	1.04
37.0	1.03
40.0	1.02
45.0	1.01
∞	1.00

A simple RETURN-LOSS BRIDGE and DETECTOR can be used to accurately measure Coaxial Cable Lengths for phasing Antennas.

MEASURING COAXIAL-CABLE LOSS:

Short or Open the Far End (An open End may give an Error at High Frequencies due to Fringing Capacitance).

$$\text{Cable Loss (dB)} = \frac{R.L.}{2}$$

Dale Clement : A+1'1 ...
9 March, 2008

THE DECIBEL (dB)

his is a very useful expression of Relative Power Ratios.
'B represents a Power Increase; −dB represents a
wer Decrease. A 1 dB change in sound (or radio energy)
. be barely detectable to the human ear.

$$dB = 10 \log_{10} \frac{b}{a}$$

, where a = original Power.
b = new Power.
$\log_{10}$ = logarithm to Base$_{10}$.

Each 1dB Increase means that Power has gone up 1.26 times! *
(*Actually 1.2589254 times, but 1.26 is close enough!)

Each 1dB Decrease means that Power has gone down by $\frac{1}{1.26}$ times, or to 0.794 of its original value.

dB	RELATIVE POWER LEVEL. INCREASE.	DECREASE.
0	1	1
1	1.26	0.79
2	1.59	0.63
3	2.00	0.50
4	2.52	0.40
5	3.17	0.31
6	4.00	0.25
7	5.04	0.20
8	6.35	0.16
9	8.00	0.13
10	10.00	0.10
11	12.6	0.079
12	15.9	0.063
13	20.0	0.05
20)	100	0.01
30)	1000	0.001
40)	10,000	0.0001
50)	100,000	0.00001
60)	1,000,000	0.000001

Note that decibels are simply added or subtracted, whereas actual power ratios must be multiplied.

→ 0 dB means No Change. ←

Worth Knowing!

+3dB means Doubling your Power.
+6dB means Quadrupling Power.
+10dB means increasing Power 10 times.

−3dB means Halving your Power.
−6dB means decreasing Power to 1/4.
−10dB means decreasing Power to 1/10.

→ decibels denote an increase or decrease; ← they do not tell you what the actual amount of Power is. If absolute Power Levels are important, then a reference must be stated. For Example, dBw means "decibels relative to 1 watt," where 0dB represents 1 watt.

These are for Antenna Gains.

dBm means "decibels relative to 1 milliwatt," where 0dB represents 1 mW.
dBi means "decibels relative to isotropic", where 0dB represents an Isotropic Radiator.
dBd means "decibels relative to a dipole," where 0dB represents a 1/2λ Dipole Radiator.

Ed. Note: Thanks to Jim, W9JUG for his contribution. I do hope I got them all in proper order. Also thanks got to Jim K9KUZ for his article as well.