HFC Network Powering for the New Generation of Applications

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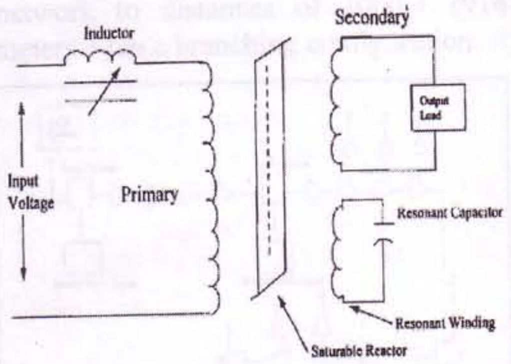
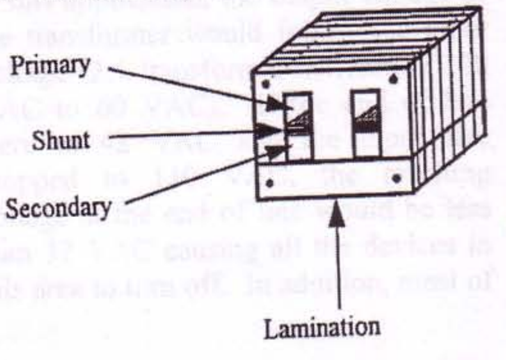
Ferroresonant transformers have been utilized in the CATV industry for many years. The inherent short-circuit protection that they provide protects



both equipment and technicians from surges caused by accidental shorting of the cable center conductor to ground. A ferroresonant transformer is composed of two main components, a saturating transformer and a resonant capacitor. When voltage is applied to the main winding, the magnetic flux path becomes excited and sets up a resonance in the "tank circuit" or capacitor winding. The resonant capacitor and winding generate high currents that `saturate the transformer and act as a "flywheel" which resists change. Once this has happened, any variations in the input line voltage will be resisted and provide for a wide range of input voltage.

The load on the secondary is regulated by he use of shunts as shown opposite[(1)]:

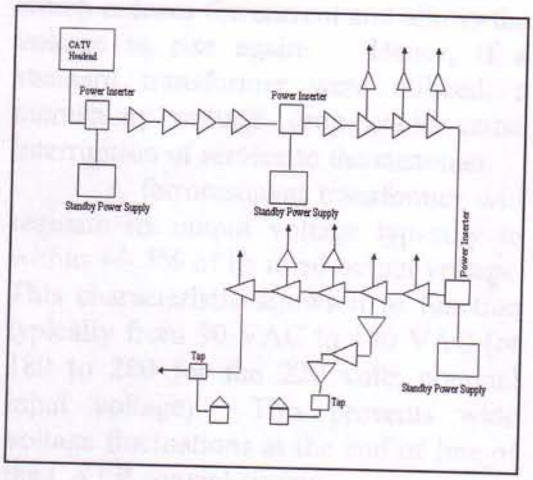
These shunts limit the magnetic path based on the air gap that is designed for the transformer. If the load on the secondary or output winding is increased, the resonance of the magnetic circulating paths decreases. To achieve load regulation, the effect of the shunts on the main magnetic path also decreases allowing more power from the primary to pass to the secondary. If a short is applied to the output, the transformer will "fold-back" or current limit because the resonant circuit will collapse similar to breaking the drive belt from the flywheel. Fold-back normally occurs at 150% of the rated load of the transformer. Most modern ferroresonant transformers have a higher fold-back current to allow them to operate into the highly capacitive loads in use in today's coaxial networks. All power sources utilized in the communication corridor must be "inherently current limited as per the NESC (National Electrical Safety Code). Most municipalities adopt the NESC guidelines as an enforceable code. In addition to the power characteristics of the transformer, it also has good RF



isolation characteristics separating the input from the output.

Why Use a Ferro Transformer?

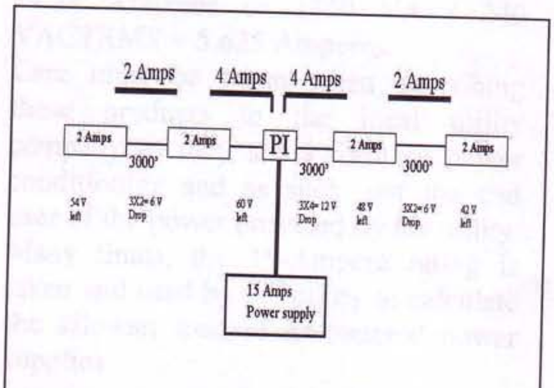
When a source of power is introduced into a coaxial cable, transmission losses are incurred based on the circuit resistance to the load. The RF amplifiers can draw from .3 amperes of current to as much as 1.75 amperes of current dependent on the design and function of the device. These amplifiers are distributed on the CATV coaxial network to distances of 3000'+ (914 meters +) in a branching configuration.



Ohms law dictates that there will be voltage loss when a current passes through a resistance. In this example, the resistance is the coaxial cable between the power supply and the amplifier. Each amplifier has a power pack or module that converts the incoming 60-90 VAC to 24 VDC for use by the amplifier circuitry. The amplifiers combine to give the highest amount of current draw on the coaxial cable that connects the power supply with the nearest amplifier location.

An example would be:
Coaxial cable 0.750", 1650' length 0.76 ohms loop resistance per 1000'
Combined amplifier loading or current on this segment 4.2 amperes
Output Voltage 60 VAC
1650 feet x (.76 ohms / 1000 feet) = 1.254 ohms
4.2 amperes x 1.254 ohms = 5.27 VACTRMS (loss)
60 VAC - 5.27 VACTRMS = 54.73 VACTRMS at that amplifier location.

Each segment of cable with load passing on it will further reduce the voltage or a higher current draw will further reduce the voltage. By the time the designer gets to the end of line, they must stop when the voltage drops to 42 VAC the typical minimum input to the amplifiers. A pictorial representation of a typical network with a loop resistance of 1 ohm/1000 ft system designed for a minimum of 40 volts are shown in Figure 2 below:



If a standard transformer were to be used in this application, the output voltage of the transformer would follow the input voltage (2:1 transformer converting 120 VAC to 60 VAC). If the end of line were at 42 VAC and the input line dropped to 110 VAC, the resulting voltage at the end of line would be less than 37 VAC causing all the devices in this area to turn off. In addition, most of