Mains supplies at remote locations

Bill Wright

from *Television*, December 1998

A simple method of obtaining low current mains voltage at locations remote from a normal mains supply. This can be used to power TV distribution or surveillance equipment. The power is carried on the coax as low voltage AC.

It often happens that the aerial contractor needs to power a device at a location where obtaining a permanent mains supply would be inconvenient or expensive. The usual answer is to carry low voltage power on the coaxial cable which also carries the signal, a practice known as line-powering. The principle is well known, and is most familiar as the means of powering masthead amplifiers from a small power supply unit at the bottom of the downlead. Power is introduced onto the coax using a simple choke/capacitor device called a line power injector. This is often built into the power supply unit. At the other end of the cable the power is extracted using a similar device.

Line powering is used extensively on communal TV systems, in countless different configurations. Remote aerial systems, where the aerial is a long way from inhabited buildings, also make great use of line power. Common voltages carried on the coax are 12V DC, 15V DC, 24V DC, and 55V AC. Any equipment along the cable, such as tap-off units or splitters, is designed to pass the power along the trunk cable but block it from spurs. DC line power has a serious practical drawback: the EMP (electromagnetic pulse) from nearby lightning tends to zap the line-powered equipment, and often the power supply unit as well. This is a common occurrence on systems which have long trunk cables running above the ground (in lofts, for instance). Presumably the long cable acts as an efficient aerial for reception of the EMP. AC line-powering is much less susceptible to lightning damage. I no longer install DC line power on new communal systems for this reason. A consequence of this is that I don't line power equipment intended to run from a local DC power supply. Some manufacturers' channel changers and channelised amplifiers, whilst not being expressly intended for line power, operate from a 15V DC supply. Normally this comes from a PSU in the same housing. There is a temptation to line-power these items—at the risk of expensive consequences next time there's a thunder storm!

The range of equipment designed to run on line power—either AC or DC—is quite restricted; in fact it consists almost entirely of amplifiers. If you need to line power a channel-changer, modulator, satellite receiver, or anything else, you have a problem. The range of amplifiers is not all that good, either, and for some mysterious reason they tend to be more expensive than their mains-powered equivalent. It was with these thoughts in mind that I considered the possibility of using mains voltage equipment at line-powered locations. The advantages would be considerable: in particular, every manufacturer's full range of amplifiers could be used, as could equipment such as satellite receivers which are only available as mains powered units. Because only a minority of the systems which I maintain use line power it isn't economic to stock a full range of line-powered equipment 'just in case'. But when these systems break down they have to be fixed 'yesterday'—there's no time to send off for spares. What a boon if off-the-shelf mains equipment could be used…

This is how I came to build the units shown in figs. 1 and 2. Conventional AC line power uses a transformer to put a relatively

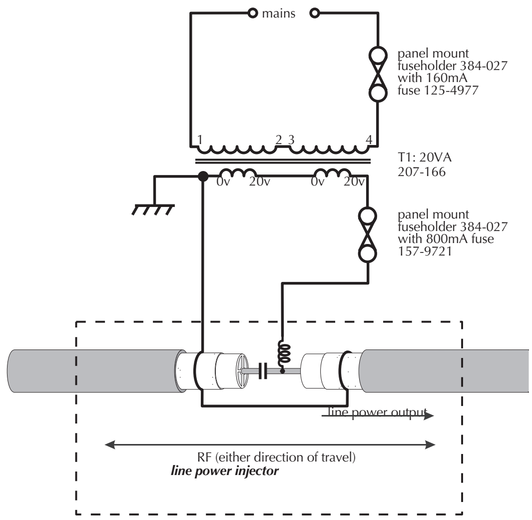

Fig.1: 240V to 40V unit

low voltage onto the coax, and the equipment at the other end of the cable is designed to run on that voltage. My units merely carry the idea a stage further by stepping the low voltage back up at the 'far' end to provide an approximation of a mains supply. They are extremely basic, but do provide an effective solution to the problem. I have used about a dozen of them over the past three years, with no problems. More sophisticated arrangements are obviously possible, as readers will, I'm sure, let me know! Likewise, there must be lots of applications for this idea which I haven't thought of. Personally, I think it's just great to be able to pick any mains powered amp out of the van and use it at a line-powered location.

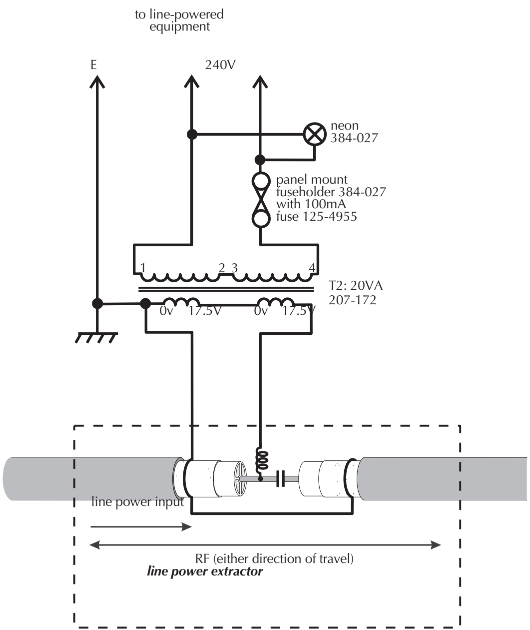

Fig.2: 40V to 240V unit

Just in case some unwary soul comes along to the line-powered equipment, sees that there is no conventional mains connection, and assumes that only low voltages are present, I always affix a large warning notice (fig 3).

It was obviously important to choose a line voltage and stick to it every time the technique was used, to simplify stock-keeping. The transformers shown in figs 1 and 2 are for 40V on the coax. Readers who follow this idea up might prefer other values.

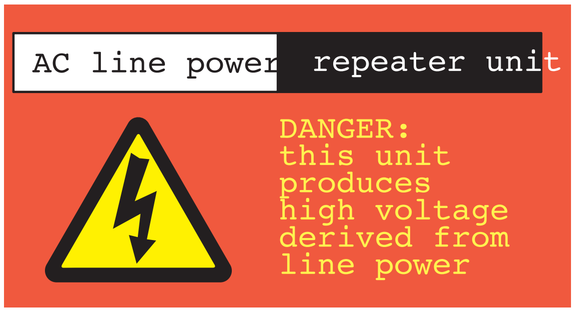

Fig.3: Safety label for line-powered equipment

If 20VA transformers are used for 40V line power, as shown in figs 1 and 2, the units will provide sufficient power for a typical load of, say, two Taylor TS3048 pre-amps and two TS2054 output amps. I suggest that readers add up the total load in order to decide on transformer ratings before using this technique. If the equipment to be line-powered includes, for instance, a couple of satellite receivers (with LNBs), channel changers, and amplifiers, then 50 or 100VA transformers might be necessary.

The different transformer ratios employed at each end of the link compensate for transformer losses and for a few ohms on the coax line. Where the coax link is exceptionally long, say 500 metres or more, the compensation will need to be adjusted upwards somewhat. Return-path resistance in a good grade of distribution cable such as Raydex CT165 is about 1.5Ω / 100 metres. In domestic downlead cable the figure is about 4Ω/100 metres.
Where one mains-powered transformer supplies several sets of equipment each on different coax lines it's a good idea to fuse

each line separately at the transformer, if only to simplify fault finding. If there are several groups of line-powered equipment along the same line (repeaters in cascade, for instance), the power to each should be fused at the line-power extractor, for the same reason.

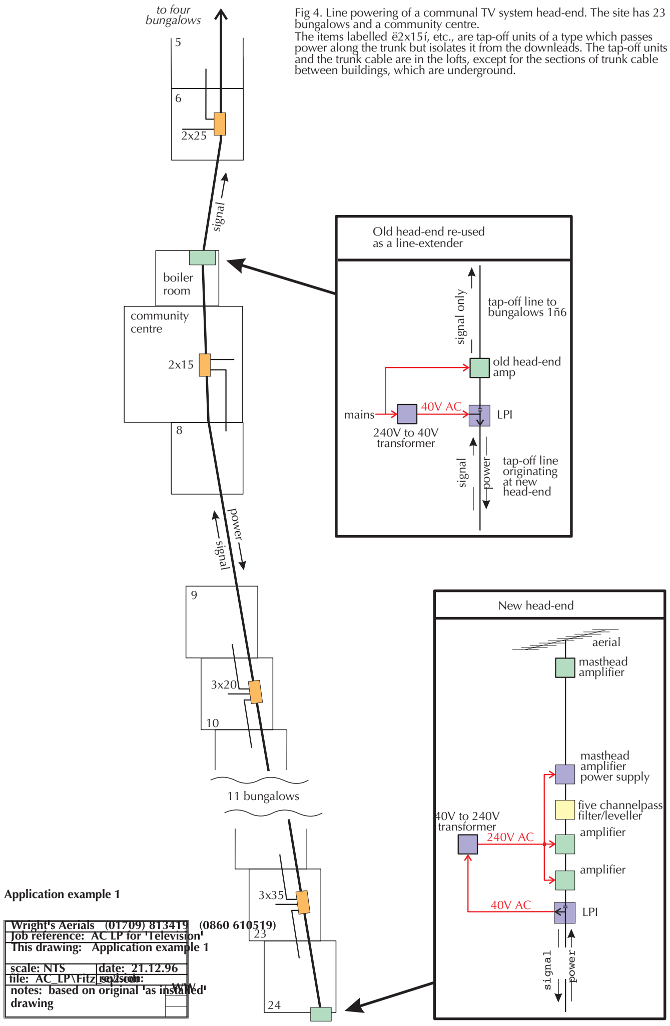

Fig.4: Line powering of a communal system head-end

There's no point in constructing an LPI (line power injector/extractor), simple as it is, because the manufactured item is not expensive and has the advantage that it includes the coaxial connectors. I use a diecast box to house the transformer and fuses, and I bolt the LPI to the outside of it. The LPI should have minimal RF through-loss and good screening. The following are just a few examples of suitable types: Taylor TRPK or TRPK-FS, Labgear CM9027, Wolsey LIU. As shown in figs 3a, b, and c, LPIs are available with Belling or 'f' connectors, or with direct cable connections. Where larger transformers are used check that the line-power injector used can handle the current. I've listed the RS stock numbers for the other components. Since only small quantities are involved it didn't seem worthwhile shopping around for lower prices.

Head-end line powered via a tap-off line

(Application example 1)

My very first use of this little line-power dodge resulted in a lot of job satisfaction, because it brought an end to ten years of abysmal TV reception for about sixty elderly people. They lived in an estate of bungalows which was in the shadow of a massive Victorian church. The church and its surrounding trees were on slightly higher ground, and screened almost all of the bungalows from the nearby transmitter so completely that good reception was impossible. Someone had installed a communal system with the head-end at the 'obvious' place—the boiler room. This was probably the worst place for off-air reception, which was appalling. After a lot of experimentation I discovered that good reception was just possible at the top of a 25ft mast on the very end bungalow. This location cleared a low part of the church roof by about a foot. I installed an aerial, and reception from it proved to be reliable, so I turned my mind to the problem of linking it into the system. It was not feasible to get a cable from the aerial back to the existing head-end – this would involve digging up the road. A better solution would be to move the head-end to the aerial location and re-plan the system accordingly. The problem was: how to obtain an electricity supply for the new head-end? The only mains supply available to me was at the old head-end position. You can't just plug in to the nearest tenant's supply, for a whole host of reasons. The electricity company would want an arm and a leg to install a new supply, and would take three months to do it. I would also have to pay a builder to recess a meter cabinet into the wall.

Line powering was an attractive option. All the tap-off units were to be checked or replaced in any case, because the original installer had done a really bad job. It would be no extra trouble to make sure that they were all power-pass types, and that there were no loose connections. The existing head-end amplifier would be re-used as a mains-powered line extender. A line extender is an amplifier fitted on a tap-off line at a point where the signal levels would otherwise be too low to supply further outlets. The system ended up as shown in fig 4. The work was carried out three years ago, and there have been no problems to date.

Aerials in a windmill

(Application example 2; see fig 5)

This happened recently—so naturally, Channel Five was the main problem!

I was faced with a development of low-rise flats that needed a communal TV system. Rooftop reception of the four Group A channels was very poor, and Channel Five, on low power and on channel 67, promised to be worse. Reception of Central as well as Yorkshire ITV was also on the residents' wish-list. Nearby, on high ground, was a derelict windmill—the perfect place for reception. Negotiations with the owner revealed that he would be quite happy to let me fix aerials on his mill, on condition that I provided a feed to his row of barn conversions. These were nearby but in the other direction to the flats. They already had a distribution system, but because the aerial was low down, reception was poor. There was no mains supply to the mill, so a line-powered head-end seemed like a good idea. Channel Five and Central ITV were on channels inconveniently high for distribution, so channel changers were required. At the time of writing we eagerly await Channel Five, but meanwhile everything else is working well.

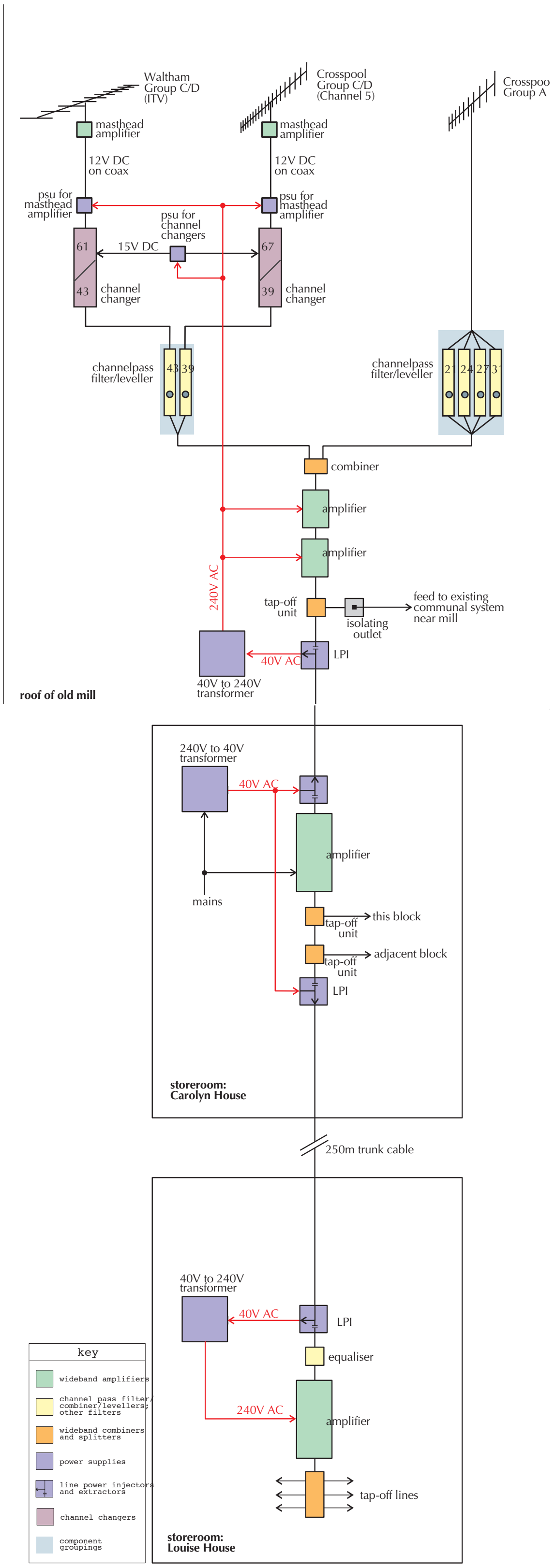

Fig.5: Application example 2