Petrol Generators for Portable SSB Part 2 of 2

By G8MNY (Updated Jul 16)
(8 Bit ASCII graphics use code page 437 or 850, Terminal Font)
Part 2

LOAD COMPENSATION
In the simple bob weight RPM control engine system, better load voltage regulation can be obtained with some additional load current feedback (feed forward) control.
This can easily be applied, by adding a small solenoid (e.g. from an old VCR) rewound with a few turns of suitably insulated & thick enamelled copper wire, that takes the 230V full load current. It is then mounted firmly on the engine or alternator & linked up to aid the speed setting spring. Even though the DC solenoid is now operating on 50Hz the pull is quite adequate if it has a fully wound bobbin.

```
                                     ┌──┐
                      CRANKCASE BOB  │()│AXLE
                     WEIGHT GOVERNOR │  │
               __ AXLE               │  │ SPRING  ___ SPEED
CARBURETTOR│()│            holes in │ :│-/\/\/\-[___[SCREW    ┌────────┐
  THROTTLE │  │         adjustment arm│ :│======================▓▓│SOLENOID│
      ARM  │__│=====================│__│        BOOST____\       └─┬───┬──┘
         GAS--->    LINKAGE       <--- REVS      PULL     / Alternator│ │Load
                                                              Neutral   Neutral
```

N.B. The solenoid pull is proportional to:-
1/ the load current squared,
2/ the number of turns,
3/ the location of the movable iron slug,
4/ the solenoid size.

Fine load compensation adjustment is best done by varying the length of the solenoid linkage (piece of coat hanger wire?)

I have done this modification to several generators now, & here is results of a 1.3kW rated (1.5kW peak) Honda generator to make it produce a steady 240V (UK).

LOAD WATTS	BEFORE MOD VOLTS	AFTER MOD VOLTS	IMPROVEMENT VOLTS	IMPROVEMENT %
0	250	250	0	0
100	240	240	0	0
500	230	238	8	3.5
1000	220	242	22	10
1500	200	240	40	20

With this modification the throttle is opened much earlier than before "when a load is applied", rather than when the engine has slowed down. So as soon as the load comes on, you hear the engine immediately "throttle up" under load, & heavy loads maintaining the voltage much closer to that of real mains! This means not only is the static regulation much better, but also the dynamic regulation as well, as there is not the usual hang time while the RPM drops before the throttle is opened.

Although this modification improves the peak load ability, the mean engine rating should be kept the same, as the cooling, bearing ware etc. are unaltered. e.g. don't plug in that 2kW heater!

LOADS TO WATCH
Switch mode PSUs loads are more immune to voltage variation, but actually exhibit a negative impedance load to the generator, so they can be the cause of voltage hunting, as the generator control loop fights the varying current to

voltage load. But normally there are no problems, & they are very efficient for /P use, if there are no QRM problems! Over voltage surge protectors are normally part of SMPSUs & may cause fuses to blow etc. if you seriously over voltage them!

Another load hazard worth mentioning are small kettles (350W) that use half wave rectification (e.g. 115V 180W heater misused on 230V with a diode by the makers!)
e.g.

```
  ┌─────────────────L────────o/o───┤>├──┐
  ( 5R lead or  240V AC  on off    80R
  (   winding   +15V DC             │  3A 50% of time
  └─────────────────N───────────────────┘  = 360W
```

On small magnetic devices like an isolation transformers or a generator the DC current will saturate the core (lock up) & reduce the inductance by many times, resulting in dramatic loss of output power or possible damage. Even on a long resistive lead on real mains, the resultant Mains + DC can damage other kit (transformers fuses especially torroidal).

Constant voltage transformers (CVTs) that are tuned to 50Hz generally are not very useful on generators feeds, as the supply frequency is not that accurate, but they will protect against overvoltage & poor sine wave at a 10% power cost.

Inductive loads like rotators & iron ballasted fluorescent lamps, are good if they are fully Power factor (PF of 0.9 = partly) corrected with a large AC capacitor.

Typically a 30W rotator transformer needs a 0.47uF @ 300V AC & a 20W fluorescent lamp needs 100VA correction that is 5uF @ 300V AC. Having them fully corrected (PF=1) helps with other peak pulse loads, as the sine wave shape is maintained!

```
   L ───────────────┬──────┐
            test C  │      ) ║ INDUCTIVE
 MAINS             ===     ) ║ LOAD
          AC AMP    │      ) ║
   N ── Meter ──────┴──────┘
```

The exact amount of C needed to tune the load can be measured if you have a bank of suitable caps to try out. Use a an AC Ammeter in series with the N wire to the load & try out various Cs in series/parallel until you find the value needed for minimum current. Warning mains is dangerous & caps stay charged!

The actual gain for a fully corrected load is small & may not actually be worth the trouble. Using mains filters & PF correction caps can degrade mains intercoms!

RMS & SINE WAVES?
As mentioned earlier the alternator design is responsible for making a good sine wave, but heavy electronic rectified loads also cause problems as the alternator will only produce an approximation to a sine wave with resistive loads.

A typical linear & electronic equipment usually draws next to no current over most of the AC cycle except at the crest of the wave when the diodes in these PSUs charge up large capacitors. The resulting pulse current can be very high, say 10A peak for only a 100W 400mA RMS computer load!

```
On real mains, the impedance is normally
only an ohm or two, with little reactance.    ┌───────10Û──┐
But a small generator is quite different     ║(  XL=        │
a 500W generator may have around 10Û         ║(  15Û      LOAD
resistive + 15Û inductive reactance.          │             │
So a high current pulse on the crest of      ~240V          │
generated output will just clip the           └─────────────┘
output to a square wave.
```

With magnetic feedback control on the generator, the true RMS power may stay the same, but real mains is normally 240V (230V EU) & peaks to 340V & your electronic equipment needs that peak voltage to work properly, & not some clipped 240V square wave that has the same RMS voltage!

```
340v PK_│    __                      │            GENERATOR WITH
240v____│   /  \ Sine Wave     ?? PK─┤ ,-──,   RECTIFIED LOAD
RMS     │  │    │  MAINS             │ │    │
     0v─┤ |- - - |- - - |         0v─┤ |- - - |- - - |
        │         │    │        254v_│         │    │
        │          \__/         RMS  │         `──--'
```

So to partly remedy this, some over voltage is desirable, say 253V, the mains maximum. But at this voltage resistive loads like lamps & valve heaters will have reduced life, but the HT or PSU headroom will be a little more like normal!

ACOUSTIC NOISE

There are 4 main sources of noise in any engine..

1/ Engine air intake, a pulsed suck at 50Hz on 2 strokes & 25Hz on 4 strokes.
2/ Engine mechanical noise, bearings, big ends, 4 stroke valve gear, couplings.
3/ Cooling air rush, through Engine & Alternator, higher pitch fan blade noise.
4/ Engine exhaust noise, both from the silencer output & from silencer walls.

1 & 4 change quite a bit with load, with higher frequency components at low loads to loud predominately lower pitched note under heavy load. Other noises are often mainly rattles of loose parts.

With their higher compression & very explosive combustion, Diesels are always noisy (Typically 20dB worse than Petrol), often from the clanking movement in heavily worn highly stressed parts.

The restriction on gasses to & from the engine degrade performance, which is why you do not see mufflers & silencers on racing cars or aircraft.

Commercial industrial generators never used to have much more that small "tin can" as an exhaust silencer, & an oil bath air filter housing designed for cleaning, but no muffing action was normal. But since more awareness of the dangers of noise at the work place etc. modern generators are much quieter.

Old slower running 4 stroke generators with 4 poles (1500 RPM) seem much quieter with their 12Hz exhaust pulse, but they are often VERY heavy for their rating, as a much larger flywheel has to store energy for 7 load half cycles before the next compression & then explosion.

```
                                          108 dBA @ 5M
Noise screens can               _   In___Ex
work very well in        Four | |  |Genny|  HEAT
the open, here is        Hay  |_|  |_____|  SIDE
a good example.          Bail | |_ _ _ _
```

```
                       Wall |_|_ _|_ _|

                            78dBA @ 5M
```

SAFETY
Exhaust gases, these are dangerous & engines should never be run for any time in an enclosed area! E.g. no more than 1 min in a garage !

Earthing, needed for safety to reduce the chance of shock, but floating generator supplies are generally much safer from this point of view than the normal N & L mains. This is because it is almost impossible to get a significant shock current to earth from either power line.

```
 _________             __________
|GENERATOR|=======================| RADIO TX |  \|/
| CHASSIS |       FLOATING        |  & AERIAL|---'
|& SOCKETS|_      240V AC          ~~~~~~~~~_|_
 ~~~~~~~~~_|_    (typically)             EARTH
 EARTH STAKE     ( 2x 120V )             STAKE
                 (off earth)
```

With actual balanced supplies 120-0-120V where the 0V is hard grounded (e.g. 110V building site transformer) there is still a shock hazard, but much reduced. But the current from either side of feed needs fusing, or you could do welding to earth with it!

I always use an earth stake to provide some static protection at least. I use a large galvanised T section one with an eyelet for the security chain too.

Some generators warn you not to use both DC & AC outputs at the same time. This may not be due to a loading or regulation problems, but due to safety! This is because the DC output winding is often part of the 230VAC load winding, & that can put DC onto the AC output or bypass some of the safety trip features, as well as MAKING THE 230V NON FLOATING & therefore more hazardous!

If you intend to use both at once do at least use a ELCB/RDC mains trip plug!

Generators are also HEAVY, especially if fully fuelled. Accidentally dropping one on your foot is unlikely to brake the generator, but your foot is something else? Backs to are a human weak spot, so get help/lift correctly!

Another problem is bad weather (typical contest Wx). Some generators suck in large amounts of damp cooling air for the alternator. So insulation breakdown of the windings will eventually happen if high levels of moisture are always around! So during maintenance the odd spay off light oil/damp start plastic sprays (not on the slip rings!) may prevent this!

Under rainy field day conditions try an awning or an old gazebo to take the worst of the Wx off the generator.

The risk of FIRE is always present, whether from a damaged carburettor pipe, or spilling petrol on to a hot exhaust. When generators are ready to run or running, a good fire extinguisher (power/gas type, NOT WATER!) placed nearby & not too close is essential.

Some generators have small tanks & others have quite large "safari" tanks. Obviously the small tanks are safer from the fire point of view with less fuel to "go up", but filling up more often soon negates this safety advantage.

Spilt Diesel Oil is also a fire hazard if there is any wickering material like dry grass, straw or even dry soil around & a flame source.

Obviously don't let people smoke near the generators or fuel tanks. If you allow public on the site, then sign the fact. In still air Petrol vapour hangs around & a dropped hot fag end can start a fire at least 20m away!

One point from Ralph G7IED, was a report of an exploding generator harming nearby people with shrapnel. This is very rare & might be related to over revving, bits that could fly out of an engine are the conrod & the flywheel, most other bits do not have enough energy, so flying bits from a working engine with it covers on is very rare.

SECURITY
Generators & full petrol cans, laying about in a field are a magnet to some types of people. One advantage of using a large earth stake with a welded eyelet is it can be used to chain & padlock up generators. Even chaining 2 generators together may make then too heavy to move.

A local club has lost a large running generator 50M away, they went to see why the power had stopped, only to see a pickup truck driving off with it out of the field gate!

I have never lost a generator to thieves so far, but I have lost full 5 gallon Gerry cans, so I now lock them up as well!

The end.

See also buls on "Cheaper Generators", "Regulating 12V Generator Output" & "Madusa SIP 2300 Generator Repair"

Why Don't U send an interesting bul?

73 de John G8MNY @ GB7CIP