Amplifier Burst Testing John L Stewart P.Eng

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When your amplifier is driven hard, it’s power supply in most cases will sag. There are few exceptions. Even a Class A amplifier pulls a little more current at full output than it does at no signal. As you progress into Class AB & farther, the output stage will need more current & your power supply voltage will drop even further. Because of cost it is customary that only instrumentation amplifiers have a regulated power supply.

Yet, one of the most commonly used checks tests amplifiers at full single tone CW (Continuous Wave) output, usually one KHz. That’s unrealistic since no sane person would last long listening in that kind of environment. If your ears didn’t fail then your loudspeaker probably will. If your program material has a 60 to 80 db (or whatever) dynamic range then what can you do to get some measure of the real output (headroom) available? What is the output capability of the amp for a short burst? That's a realistic test since that is how most of your program material is available.

There are several ways in which a tone burst can be produced so that your amp can be tested in this mode. This is one of them. This simple gate circuit allows you to apply tone bursts to the amp in test. The signal originates in your existing audio generator. The gate can be set to allow a few cycles of the test tone through & then blocks the signal.

Repetition rate of the tone bursts is set at about 14Hz but could be varied. Now power output measurements can be made while full power supply voltage is applied to the amplifier. You will need an oscilloscope on which to observe & measure the test results.

The test works with any amp whether it be solid or vacuum state. It is possible to build two versions. The simpler depends on your scope having a sweep gate connection, usually found on the rear panel. If that is not available a three transistor gate driver with synchronizing of the gate to the audio generator source can be added. Nothing is wasted.

All can be done for less than $100.00. I built mine in a Hammond 5 x 13.5 x 2 chassis so that it fits right under my scope, where it can stay. Many of the parts came straight out of my junk box!!!

THE GATE

The gate itself is nothing more than a pair of back to back connected Hammond interstage transformers, switched by a pair of diodes. Refer to Figure One, The Gate. One of the connectors on the rear of my scope is a positive pulse in time with the horizontal sweep. The sweep gate pulse drives the diodes D1 & D2 into conduction & the test tone passes through to the output terminals. Diodes in my final version are very old 1N478's, mostly because I had some. They are Germanium, so I thought they might work better because of the low forward drop. I did try a variety of other diodes as well. The silicon power diode series 1N400X works almost as well. I inserted a three volt reverse bias (two "AA" cells) into that lead so that the tone can't leak thru while the sweep gate is absent.

The DPDT switch S3 allows either continuous or burst signal mode to be selected. As shown it is in the burst position. The switch section S1c is part of the on-off switch, the rest of which is appears in the Gate Driver schematic. The 4PDT switch S2 allows the test set to be completely bypassed.

Because the circuit is working with a switched signal, some ringing occurs in the transformers. This is for the most part damped out by the network formed by R13, R14 & C6.

If your scope has a negative sweep gate than you could reverse the diodes & the three volt battery.

GATE DRIVER

If your scope doesn't have a sweep gate or you would like a more comprehensive piece of test equipment, you can drive the gate in a number of different ways. Here is how I did it, mainly because I had these parts in my stockpile. Refer to Figure Two, the Gate Driver.

The gating pulse is provided by a one-shot multivibrator consisting of a pair of 2N3053 NPN transistors. However the circuit is not critical & any common NPN transistor could probably be used here. The multivibrator in turn is triggered by a 2N1671 unijuction transistor. Unijunctions were at one time fairly common & I found them to be quite useful. However, they seemed to have for the most part disappeared from the market.

The duration of the gate is determined by the setting of P1, the 50K pot. With P1 set to minimum, the duration is long enough that about three cycles of a one KHz test tone get thru. The gate signal will probably not be synchronized with the audio source, so I have included a connection through C3 & R7 which will help to stabilize the scope display. As well, you can trigger your scope with the signal available from the collector of Q2 & identified on the schematic as the Gate Driver Output. I used a red binding post in order to differentiate from the other front panel connections.
An example of the output burst is shown in Figure 3.

THE UNIJUNCTION

For those who are interested, a unijunction transistor is just that. Only one junction, not two as in a regular bipolar. The base is a bar or intrinsic material with connections at each end labeled B1 & B2 (Base connections one & two). Ordinarily the base has a resistance of a few Kohms between it's ends, so that little current can flow. The emitter junction is placed part way in from one end of the bar, usually closer to connection B2.

When the bar is supplied with a voltage source, a potential gradient will result along it's length. In this case nine volts has been used. Not much happens until the 1000 nF capacitor C1 charges up to a voltage a bit greater than that which results on the bar where the emitter is attached. As soon as the emitter-base junction is forward biased current flows & discharges C1 into the base of Q2. That way the one-shot MV is triggered & a gate pulse occurs. The CR time constant I used results in about 14 pulses per second.

There are several references to the Unijunction on the web.
Refer to http://www.americanmicrosemi.com/tut...nijunction.htm
for a very good tutorial page & parts source if you decide to use a unijunction in this project.

TEST SETUP & MEASURMENT

The hookup to test your amplifier is very straight forward. The test tone from your audio generator is set to about one KHz and is not critical. The test set is connected between your tone generator & the amplifier you would like to test. Refer to the diagram showing the test setup.

Output from the amplifier goes to the vertical input of your scope. With the test set switched to the ON position there are a number of possiblities. First of all, with switch S2 set to BYPASS you can route your test tone straight through to the amplifier. Alternatively, you could set switch S2 to TEST & that way allow a few cycles of the test tone to pass. By varying the position of pot P1 you will be able to pass more or fewer cycles of the test tone.

I wanted to be able to make valid comparisons of amplifier performance both with & without the test tone gated. Because the test set has a bit of attenuation, I have included switch S3 which can set these conditions. You will notice the attenuation if you were to look at the output of the gate when the BYPASS mode is compared to the CONTINUOUS mode.

The gate introduces about 2% distortion into the signal, but for the intended application this is irrelevant. I included the BYPASS mode so that you could leave the test set connected to the rest of your setup, without having to worry about the gate's residual distortion & attenuation.

Measurements of the signal amplitude are made with your scope, much like you would normally do. What you are looking for is maximum signal output from the amplifier at the clipping point, comparing the BURST & CONTINUOUS modes (S3).

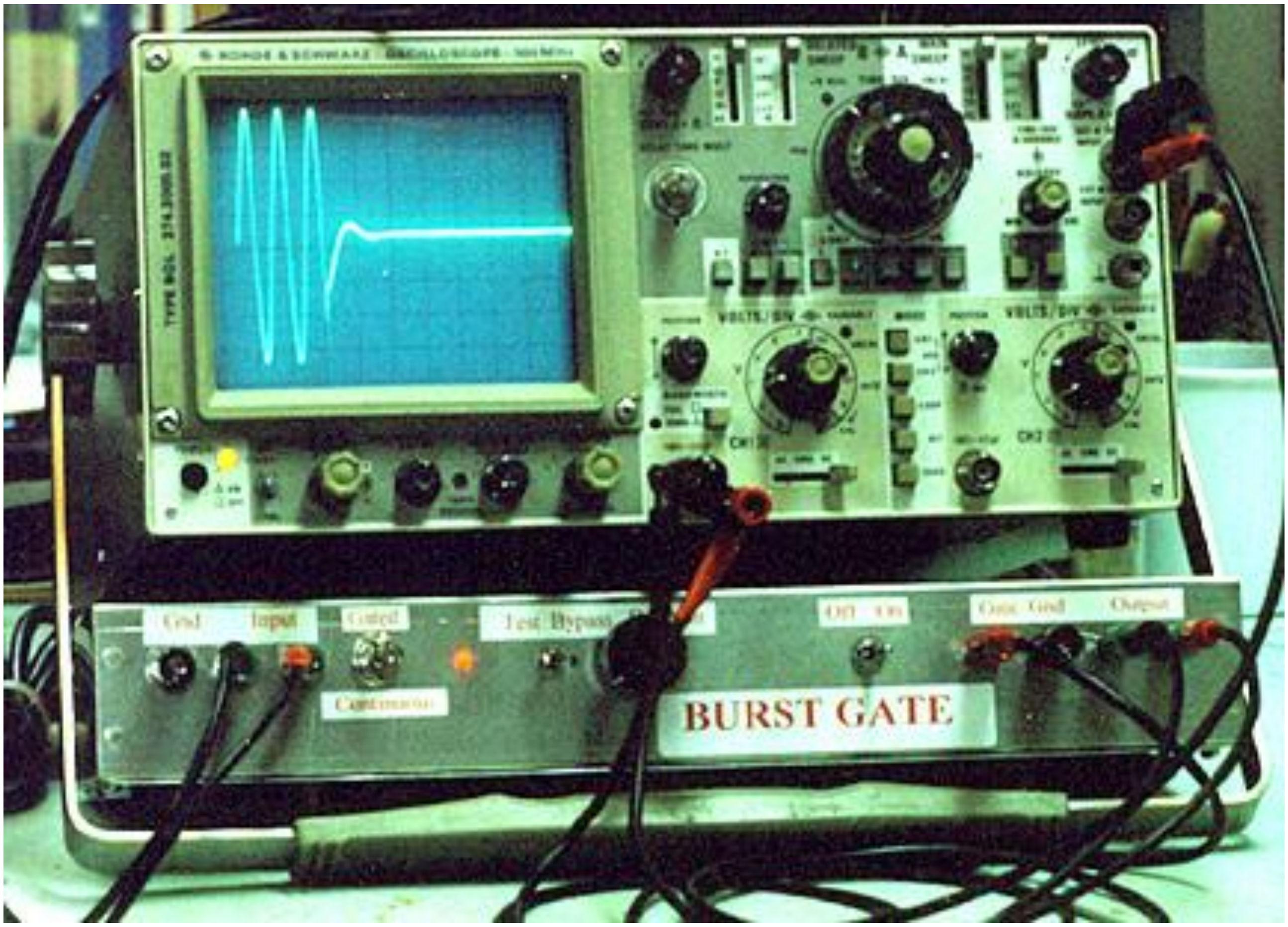
The table shows some results I measured which are fairly typical of amplifiers, especially those running Class AB & have a power supply with a capacitor input filter. This particular amp is push-pull 6V6GT's running in Class AB2. A 6BQ7 drives the output grids into conduction. The power supply is a small Hammond device rectified by SS diodes & into a capacitor. The test results are quite an eye opener that would not be obvious by other test methods.

When tested by the normal CW method the scope trace had a maximum amplitude of 17.5 volts at clipping. That translates to 12.4 vrms. The load resistor used measured 7.85 ohms cold, so the output was 19.5 watts. When tested using the gated tone burst the maximum amplitude measured at clipping on the scope was 20.2 volts. That translates to about 26 watts!! Another advantage of burst testing is that your load resistor doesn't change value due to heating while in the burst mode.

CONSTRUCTION

I built my burst tester into a small aluminum Hammond chassis which easily fits under my scope. So that the front face would be tilted up I installed a pair of 8-32x 1.25" machine screws with locking nuts in the bottom plate. These are placed about 1.5" to one side of the long dimension of the bottom plate center line with their heads facing down. You may choose some other method to improve access.

The pair of double "A" cells (B3) are enclosed in a Radio Shack holder. I used two sided sticky tape to mount the assembly to the inside of the chassis. If you use alkaline cells at this point they will probably last for at least five years, their normal shelf life, since the current requirement is minimal. The two 9 volt batteries are simply held in by a short length of #14 solid copper wire with the insulation still attached. The wire is secured to the chassis with 6-32 screws. Again, if you use alkaline batteries they should be good for 50 to 100 hours operation in this circuit.
John L Stewart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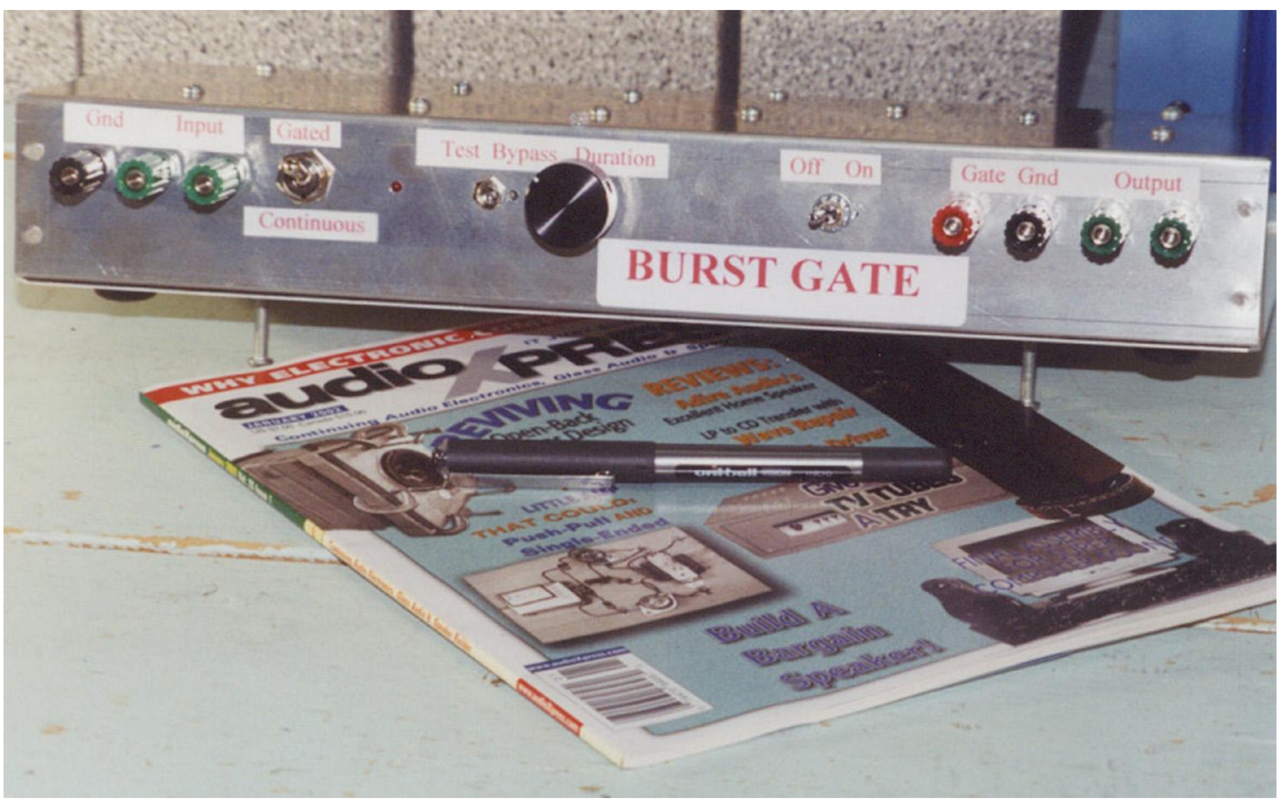
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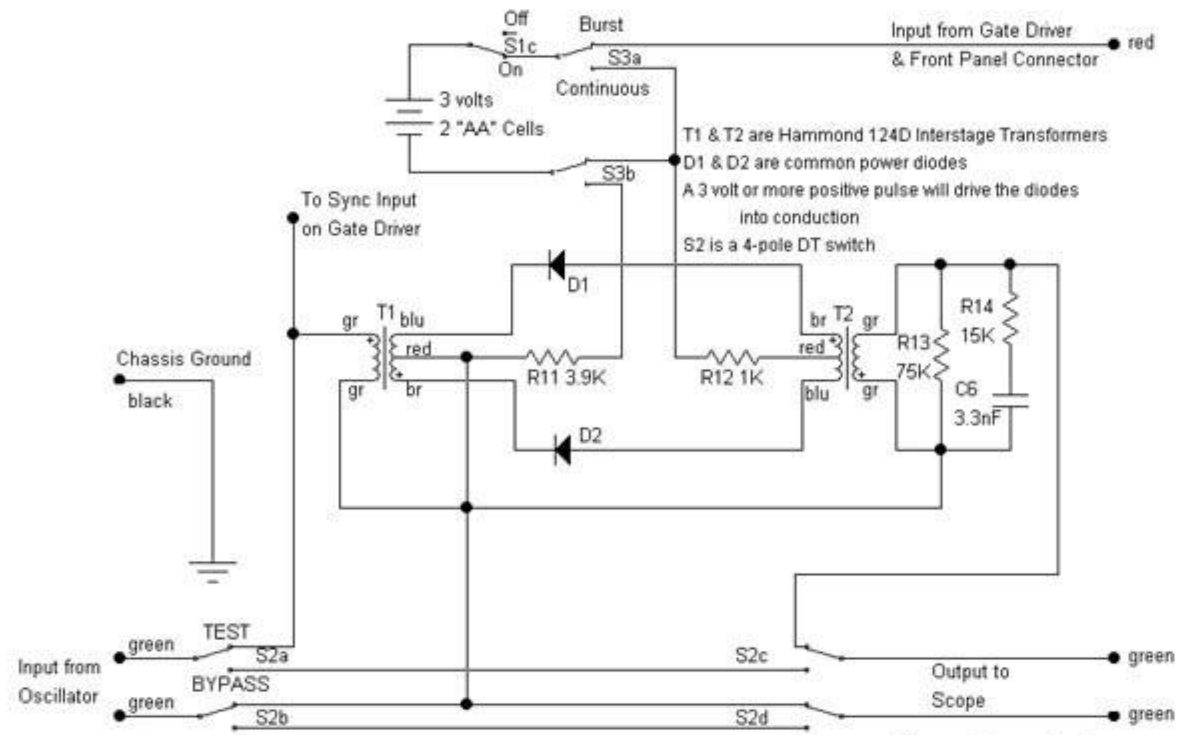


Figure One- Gate

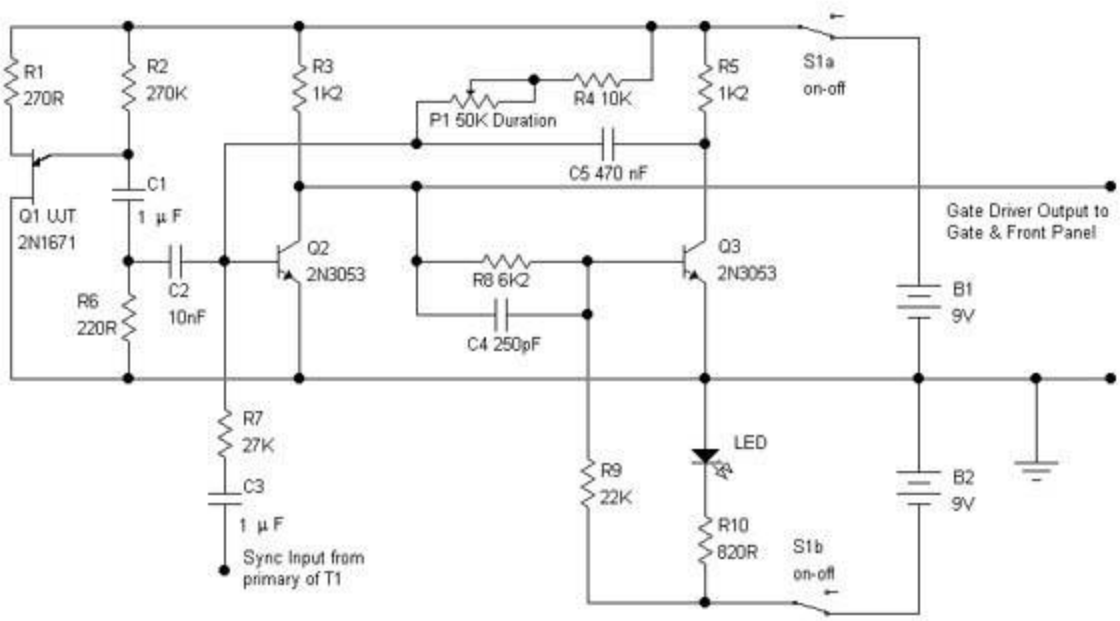
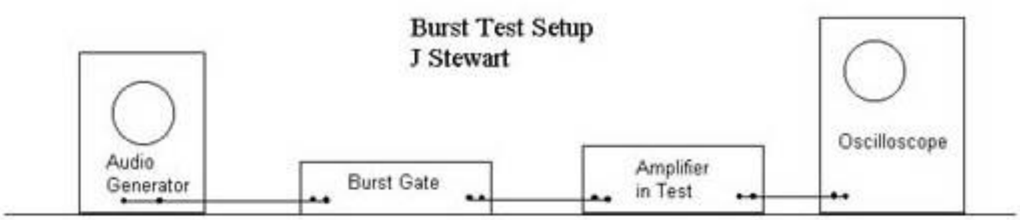


Figure Two- Gate Driver

Burst Test Setup
J Stewart



Parts List

C1	1 microF	C2	10 nF
C3	1 microF	C4	250 pF
C5	470 nF	C6	3.3 nF
R1	270R	R2	270K
R3	1K2	R4	10K
R5	1K2	R6	6K2
R7	27K	R8	22K
R9	22K	R10	820R
R11	3K9	R12	1K
R13	75K	R14	15K
B1, B2	9 Volt	B3	2X "AA" Cells & Holder
D1, D2	1N400X or see text	D3	Red LED
P1	50K Pot & Knob		
Q1	2N1671 (see www.americanmicrosemi.com)		
Q2,Q3	2N3053 NPN		
S1, S2	4PDT Switch	S3	DPDT Switch

7 Binding Posts

Various Terminal Strips, Machine Screws & Nuts

T1, T2	Hammond 124D
Chassis	Hammond 1441-18 (steel) or 1444-18 (aluminum)
Bottom	Hammond 1431-18 (steel) or 1434-18 (aluminum)

All resistors are 1/2 watt

All caps are low voltage

Most parts are available from Antique Electronic Supply www.tubesandmore.com

& Radio Shack

Condition	Power Supply Volts	Plate Current mA	Power Output Watts
No Signal	342	60	zero
Burst	341	61	26.1 Burst
CW	281	142	19.5