Industrial Electronics 1200B: restoration and a 405-line television

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The scope

The Model 1200B is a small oscilloscope built by Industrial Electronics of Derby Road, East Sheen, London, between about 1951 and 1954. It is a well-made instrument:

- a 7 cm Mullard **DG7-5** tube, green, with electrostatic deflection
- **DC-coupled push-pull amplifiers** on both axes, each a pair of EF36 valves, flat from DC to about 100 kHz
- a **6K25 gas-filled thyratron** time base, 5 Hz to 20 kHz in five ranges
- a 6X5GT HT rectifier giving about 400 V, and a separate half-wave EHT supply of about −850 V
- both pairs of deflection plates and the CRT grid brought out to a terminal board, with a GRID socket on the panel

This one had been partly restored at some point before I got it. That earlier work turned out to matter, as described below.

The plan: a 405-line television

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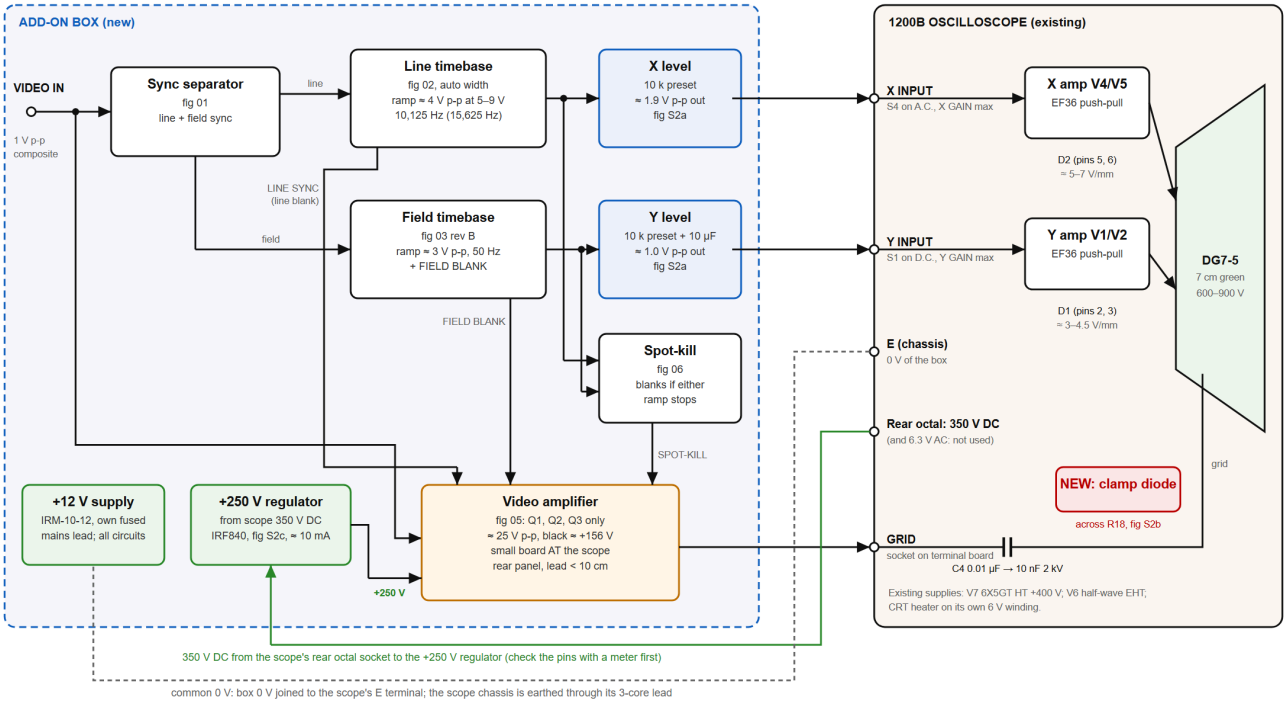
Most of a 405-line picture monitor is already inside the 1200B: a tube, an EHT supply, and two DC-coupled deflection amplifiers. What it lacks is something to make a raster and put the picture on the grid. Rather than rebuild the scope, I'm adding an **external box** that does that job and plugs into the scope's existing inputs.

Figure S1: Industrial Electronics 1200B oscilloscope as a 405-line TV, add-on box and connections

The scope keeps its CRT, EHT, HT and X/Y deflection amplifiers. The box makes the ramps and the video drive. Figure numbers are the VCR139A monitor report's.



Picture 48 × 36 mm (4:3) inside the 7 cm screen: X needs ≈ 230–340 V p-p between the D2 plates, Y ≈ 110–160 V p-p on D1 (EHT 600–900 V). Scope sensitivities ±20 %: set the presets on the bench.
Both scope gain pots at maximum: the manual warns they are not frequency-compensated and lose HF part-way round. The internal gas-triode time base is switched out (S4 on A.C.).
Untested design. Recap and check the 1950s scope (report §4) before connecting anything.

The box reuses modules from my VCR139A television monitor:

Module	Job
Sync separator (LM1881, Addendum A)	Takes composite video and gives line and field sync
Line timebase	A 10,125 Hz ramp, fed to the scope's **X** input
Field timebase	A 50 Hz ramp, fed to the scope's **Y** input (DC-coupled)
Video amplifier	Drives the CRT grid through the scope's GRID socket, with line and field blanking
Spot-kill	Blanks the beam if either ramp fails, so a still spot can't burn the screen

The only change inside the scope is a clamp diode on the CRT grid, so the black level stays put. It unsolders to turn the instrument back into a normal oscilloscope.

What to expect: a picture about **48 × 36 mm**. The DG7-5's spot is about 0.7 mm across, so the picture resolves roughly 50–70 lines rather than the full 405. It's a small, soft picture, but a real 405-line one on a 1950s tube. The same box also handles 625 and 525 lines.

Progress so far: the LM1881 sync separator and the line timebase are built and tested on 405 and 625 lines. The field timebase is next.

The restoration

Replacing the capacitors

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Before using the scope as the heart of a television, I replaced the capacitors most likely to fail:

- **C5 and C6**, the EHT smoothing capacitors (0.1 µF), with film types rated 2 kV
- **C7**, the HT reservoir and smoothing electrolytics (8 µF + 16 µF), with new 500 V capacitors

The fault: a spot but no sweep

At switch-on the EHT was fine (−850 V measured) and there was a sharp spot, but no trace. The time base wasn't sweeping the beam. I worked through it one measurement at a time:

1. **The X amplifier.** X SHIFT moved the spot, and a sine wave on the X input drew a line, so the amplifier itself worked.
2. **The HT line.** With the X valves removed, the X SHIFT pot should sit at the full +400 V. It read only about 200 V. A **red wire carrying +400 V to the X SHIFT wiper had come off the tag board** while I was working near C7. Reconnecting it restored full X deflection.
3. **The time base.** The 6K25 is metallised, so you can't see it glow. Its heater was fine, but there was no voltage on its anode. Feeding the charging resistor R11 straight from HT made no difference, which put the break between R11 and the valve.
4. **The cure.** A wire from the top of the VELOCITY pot to the tag strip brought the time base straight back. The pot had **lost its supply connection**.

Earlier repairs found along the way

The scope is not wired exactly as the manual shows:

- Two modern **4.7 kΩ resistors** had been added in the two positions marked "R10" on the maker's layout sketch. The circuit calls for 100 kΩ (R10) and, almost certainly, 1 MΩ (R12). I've fitted 100 kΩ in both for now.
- The **VELOCITY pot** measures about 500 kΩ, where the drawing specifies 5 MΩ in parallel with 10 MΩ (3.3 MΩ).
- The maker's sketch itself has errors, such as "R10" appearing twice.

I've drawn up a sheet of both group boards with the drawing's values and the voltage to expect on every tag. It's a starting point for recording how this particular scope is really wired.

Still to do

- Confirm the time base's new supply runs through R11, so VELOCITY can't feed V3 straight from HT
- Settle the values in the two "R10" positions, using a 2 W resistor for R10
- Check the focus divider (R17, R23, FOCUS and BRILLIANCE). Focus needs attention
- Reflow the joints on the +400 V line. An intermittent joint is the likely cause of the Y SHIFT crackle and the vertical jumping seen earlier

Watch the restoration

The fault-finding is on YouTube: https://www.youtube.com/watch?v=m3jdDSxH0nI

Documents

- *Original instruction manual:* the maker's manual, with layout sketches and the circuit
- *Circuit diagram:* the maker's drawing, upright
- *Conversion report:* the full design of the add-on box and how it connects to the scope
- *Addendum A:* the LM1881 sync separator

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- *Parts list* for the add-on box
- *Time base and X amplifier fault sheet:* valve pins and expected voltages
- *Group boards:* component values and tag voltages

Safety: this scope has about 400 V of HT and −850 V of EHT, and both can kill. Discharge C5, C6 and C7 before touching anything inside, and work on equipment like this only if you know what you're doing.

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