The Guzik MR Amplifier Revision 5 is a next generation of the Guzik head amplifiers. The main advantages of the Guzik MR Amplifier Revision 5 comparing to the Revision 4 are:

- **Fast rise/fall time of the write current (300psec instead of 800psec)**
- **Programmable overshoot of the write current up to 100%**
- **High bandwidth of the read amplifier (1.5GHz instead of 400MHz)**
- **Small write to read recovery time (less than 200nsec comparing to 2\(\mu\)sec)**
- **Supports heater (single-ended or differential)**
- **Microactuator compatible**
MR Amplifier Revision 5 Specifications:

**Read Amplifier**

- **Differential voltage sense amplifier**
- **Bandwidth:** 1.5GHz at –3dB
- **Flatness:** ±0.5dB, 0.3 to 1GHz
- **Input noise:** less than $0.6 \mu V/\sqrt{Hz}$ (typ.)
- **MR bias current:** programmable –5 to +5mA* in 0.01 mA steps
- **Common mode rejection ratio:** TBD
- **Non-linear distortions (1GHz, 1mV input level):** less than 1%
- **Amplification:** 30dB**
- **Write to read recovery time:** less than 200nsec for both **Bias On** and **Shut Down Bias** modes***
- **Input impedance:** at 1GHz TBD
- **Guzik MR5 head amplifier compatibility:** with Universal Preamplifier UP8 only.
- **MR head impedance range:** 20-100Ohm

**Write Driver**

- **Write data speed:** up to 2Gbit/sec
- **Rise/fall time of write current:** (10-90%) 300psec****
- **Programmable overshoot:** up to 100% of write current in 1% steps
- **Output common mode voltage:** less than ±0.1V
- **Write current:** programmable 2 to 100mA (zero to peak) in 0.02mA steps*****
- **Read to write recovery time:** less than 40nsec
- **Head voltage swing:** more than 12V peak to peak
- **Output impedance:** 100Ohm differential

* The MR bias current is limited in hardware to protect the GMR element of magnetic head. Some customers are using the modification with ±20 mA MR bias current.
** Required amplification is provided by UP8.
*** Measurements conditions: write current 50mA, head inductance 20nH, and write data 1Gbit/sec.
**** Measurement conditions: write current 50mA, 100% overshoot, L=20nH in series with R=20 Ohms, current probe Tektronix CT-6.
***** Maximum overshoot value in 50-80mA write current range should be calculated as $I_{overshoot} + I_{write} = 100mA$.

**Heater Features:**

**Single-ended heater**

- **Output heater voltage:** from 0 V to 5 V
- **Maximum output current:** 250 mA
- **Two types of heater voltage control**
  - **Internal:** one setting for the read mode and the write mode by one DAC
  - **External (MCX connector):** input range from 0 V to 5 V, low-pass filter with 4 MHz cut-off frequency
- **Rise/fall time for external control:** 100 nsec
- **Heater current and voltage measurements:**
  - Current measurement accuracy ±1.0 mA
  - Voltage measurement accuracy ±5.0 mV

**Differential heater**

- **Output heater voltage:** from 0 V to 7 V
- **Max output current:** 70 mA
- **Internal voltage control only, separate controls – one DAC for the read mode and one DAC for the write mode**
NLTS vs Data Rate

![Graph showing the relationship between NLTS% of bit period and data rate. The graph includes two lines: one for overshoot = 0% and another for overshoot = 20%.](image-url)
**Write Current Waveform**

**Measurement Conditions**
- write current: 50mA
- overshoot amplitude: 0 to 100%
- head equivalent: 20nH + 20 ohms

Figure 1A: Write Current, Overshoot 0%

Figure 1B: Write Current, Overshoot 50%

Figure 1C: Write Current, Overshoot 100%
Figure 2A: Write to Read Recovery (Bias On)  
Figure 2B: Write to Read Recovery (Bias Shut Down)  
Figure 2C: Read to Write recovery