MX/RS Series: Simple, Direct Control of the Output

Introduction

The California Instruments MX/RS series of AC and DC power sources are capable of generating custom waveforms, harmonics and a variety of transient events, but there is also a need to easily accept a custom waveform generated by an external device. Hardware-in-the-loop (HIL) simulation is a technique that is used in the development of complex real-time embedded systems. HIL simulation provides and effective platform by adding the complexity of control to the test platform. Using the **External Drive (EXTD)** Input connection of the MX/RS allows a quick, low cost and simple solution of direct, real-time control of the output of the power supply. In many cases, this method saves time by allowing the user to generate custom waveforms without the need for converting files or learning new software platforms.

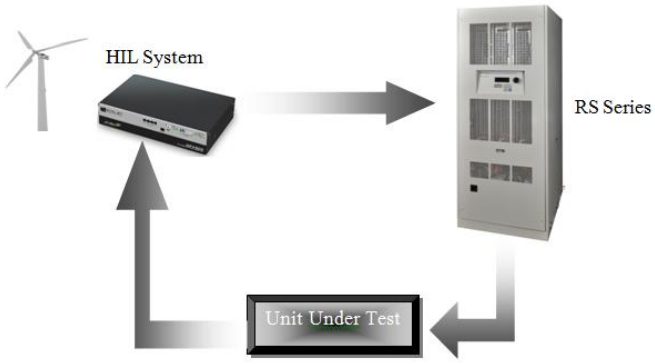
In this technical note, several examples are provided using the external drive input option to take direct control of the output. This method of control means the MX/RS is used as a high bandwidth power amplifier (62kHz MOSFET based). The MX/RS provides protection by monitoring the input for amplitude and frequency to ensure the external signal does not exceed performance specifications.

Application Requirement

HIL applications require an electrical interface to act as the interface to embedded systems and the equipment under test. HIL is commonly used to prototype systems for power grids, power electronics and hybrid electric drives. The most recent trend is modeling dispersed energy products, like a PV inverter, and the effects to the utility grid. The results that follow employed a Power Hardware in the Loop (PHIL) simulator from Opal-RT to produce user defined waveforms.

Application Solution

The external drive input (EXTD) option of the MX/RS will accept a 0-7Vac signal that will be amplified to 0-100% of the selected voltage range, up to 600VL-N (1,038L-L). When in EXTD configuration the internal controller is bypassed, yet it still maintains signal monitoring to ensure safe operational conditions. The actual output, however, is controlled directly from the external drive signal. This allows the user to easily transfer their external waveform to the MX/RS system without the use of a special file or software package.



Traditional use of measurement and control via remote interfaces such as LAN or GPIB introduces 100's of milliseconds of delay between the response and control. Combining an HIL simulator with an MX/RS-EXTD results in as little as 100µsecs latency, meaning the overall solution is 1000 times faster. **That's real time!**

Fig. 1 Input terminal block for the External Drive Signal

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Examples

The following examples are provided to demonstrate the MX/RS's response to external drive signal changes. Figure 2 is an example of a simple sinewave set to achieve 230V and 60Hz.

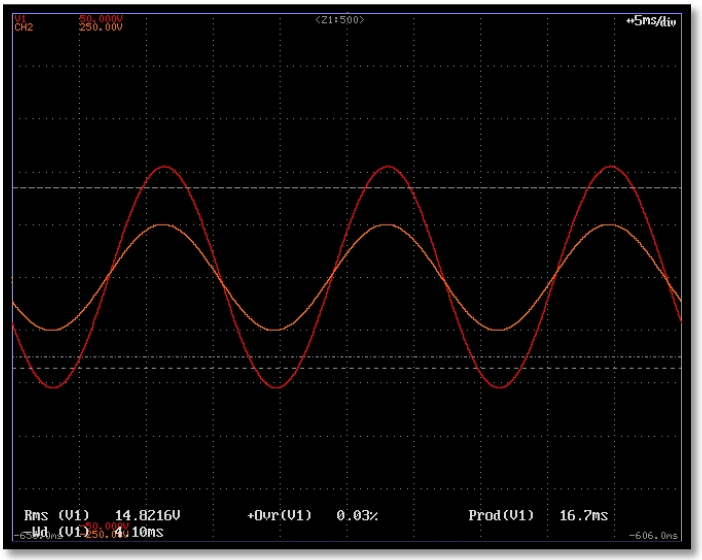

Fig. 2 Sinewave Input with resulting output. Orange is the External Drive Input signal and Red is the output of the MX/RS.

Figure 3 demonstrates a typical voltage turn ON condition. High switching speed amplifies of the Mx/RS offer high bandwidth resulting in no over shoot.

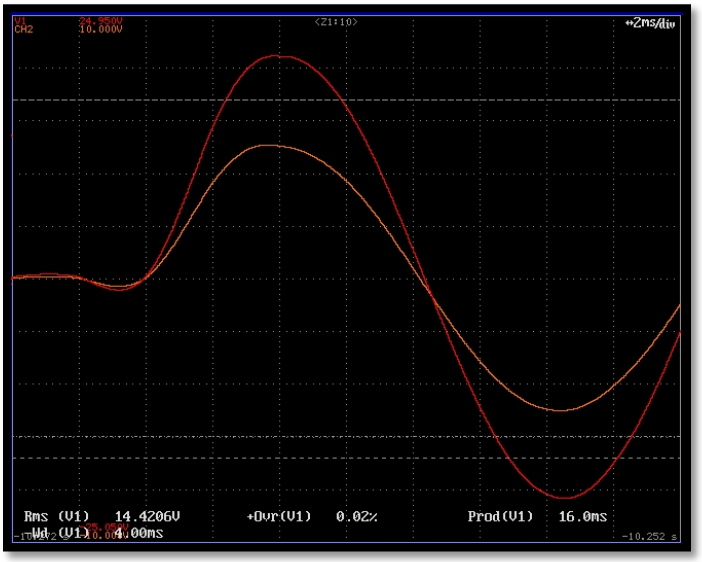

Figure: 3 Turn ON performance

Figure 4 demonstrates a typical 60Hz voltage turn OFF.

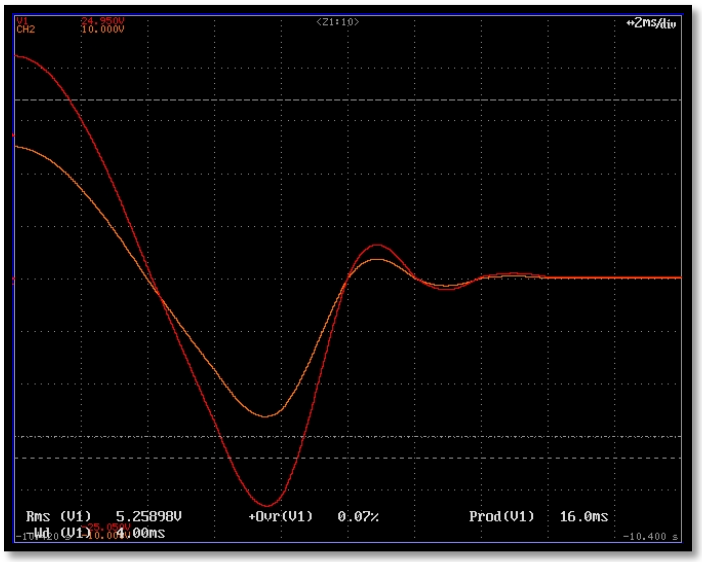

Figure 4: Turn OFF Performance

Figure 5 demonstrates amplifier performance of a squarewave output. Notice the high speed voltage slew rate of around 0.5V/µsec and roughly 100µsec of delay between EXTD input signal and source output. Please note delays can vary based on load conditions and as much as 150usec have been observed.

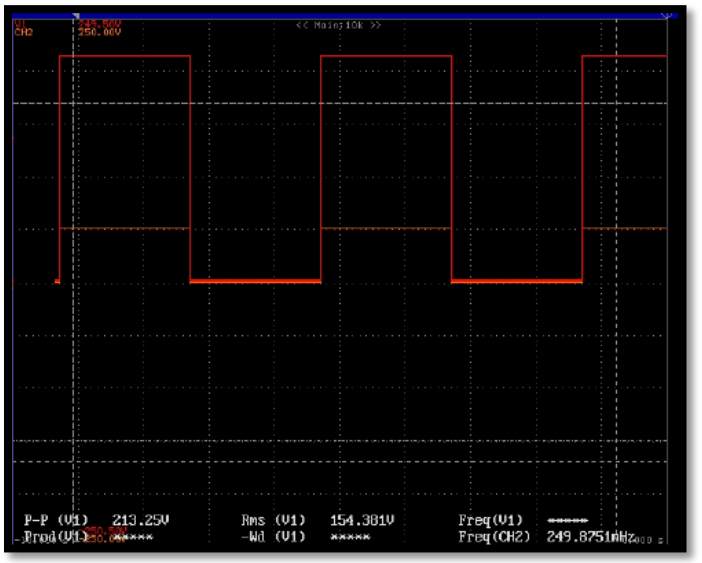

Fig. 5 Square wave performance

Figure 6 captures amplifier performance of a highly distorted waveform. While unlikely to experience such a waveform in the real world, it demonstrates the systems capability to accurately track and reproduce input signals.

Fig. 6: Highly Distorted Waveform

Conclusions

The ability to bypass the MX/RS controller to directly control the output using a quick and simple method was presented. This can be done using any arbitrary waveform generator that produces a 0-7Vac signal that will be amplified at the output of the MX/RS.

The External Drive Input option offers the Mx/RS an accurate and efficient method of real-time control of the MX/RS Series. In addition, HIL reduces costs typically associated with duration of development, safety and feasibility studies.

About the California Instruments MX/RS Series

These high power AC and DC test system cover a wide spectrum of AC and DC power applications at an affordable cost. Using state-of-the-art Pulse Width Modulation (PWM) switching techniques, the MX/RS series combines robustness and functionality in a compact, floor-standing chassis.

The MX/RS Series features the ability to both source and sink current, i.e. bi-directional current flow. The MX/RS amplifier is designed to reverse the phase relationship between the AC input voltage and current in order to feed power back onto the utility grid. This mode of operation is particularly useful when testing grid-tied products that transfer energy back onto the grid. Static Power Converts, such as grid-tied and off-grid photovoltaic inverters, are tested for frequency and voltage variations.

California Instruments MX/RS System

About AMETEK Programmable Power

AMETEK Programmable Power is a business unit of AMETEK Electronic Instruments Group, a leader in advanced instruments for the process, aerospace, power and industrial markets and a division of AMETEK, Inc., a leading global manufacturer of electronic instruments and electromechanical devices with 2013 sales of $3.6 billion.

For more than forty years AMETEK has supplied precision programmable power products and systems to diverse industries for test and measurement needs, ATE systems, R&D, process control, power bus simulation and power conditioning. Its products and services are recognized around the world for robust performance, high quality, reliability and economic value.

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