

INDICE SEMICONDUCTOR

Dimmable MR16 LED Driver Training
December 2013

INDICE DIMMABLE LED DRIVER BENEFITS



We've done the hard work in power control so that our customers can take their LED product to market quickly with ultimate confidence in reliability and an impressive feature set to differentiate their product from competitors:

- Ultra small designs due to high switching frequency (typically 1MHz+) only possible with Indice proprietary control technology
- Active temperature and power management & long operational life
- Broad compatibility with electronic transformers dimmers (leading and trailing edge)
- High power factor
- Compliant designs and capability
 - EMC compliance (US, Europe, Australia)
 - UL, FCC, CE, CTICK, etc.
- Indice LED driver IC's are at the heart of each power control reference design we develop
 - Indice LED driver IC's simplify dimmable LED driver PCB development
 - Indice LED driver IC's provide advanced power control functionality and enable excellent dimming performance

THE MR16 INFRASTRUCTURE PROBLEM



- Electronic inverters typically require 20Watts or more of resistive loads
- Inverters used require correct load to maintain oscillation, capacitances greater than 100pF can stall the inverter
- Inverters have over-current detection, currents exceeding this cause temporary shutdown.
- Typical energy saving products implement standard diode based rectifiers with capacitance for stable operation and EMC.
- Inrush currents can exceed 15Amps when inverters first start, stalling oscillation and damaging rectifiers, causing early failure in both transformers energy saving globes.

LEADING EDGE / TRIAC DIMMERS

Leading edge dimmers require minimum current draw to ensure the triac “latches” and does not misfire which will cause the LED to strobe and flicker.

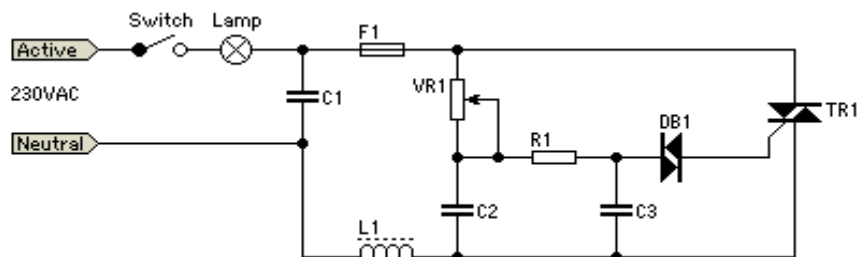


Fig 1: Triac dimmer schematic simplified

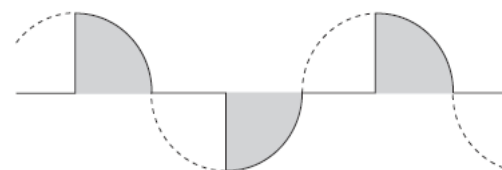


Fig 2: Triac dimmer example waveform

TRAILING EDGE / ELECTRONIC DIMMERS

Trailing edge dimmers require minimum current draw to ensure the internal electronics have enough power to remain alive. Without a minimum load current draw they brown out and misfire which will cause the LED to strobe and flicker.

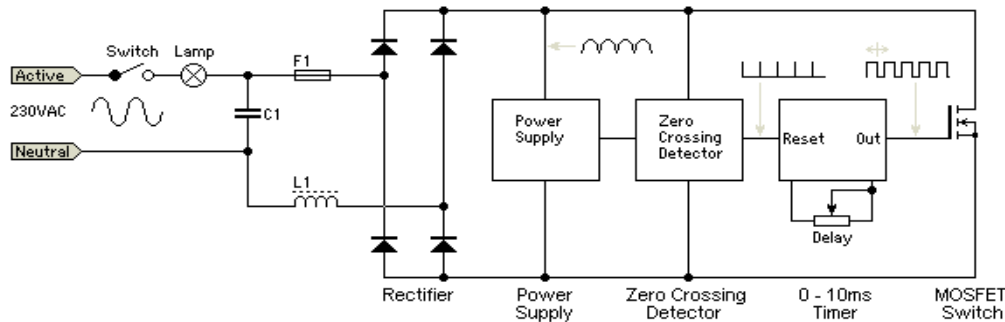


Fig 3: Electronic dimmer schematic simplified

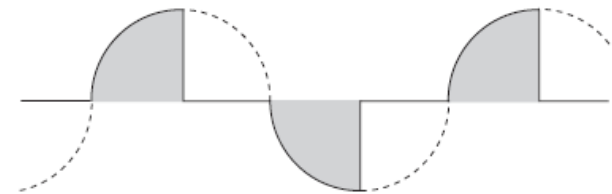
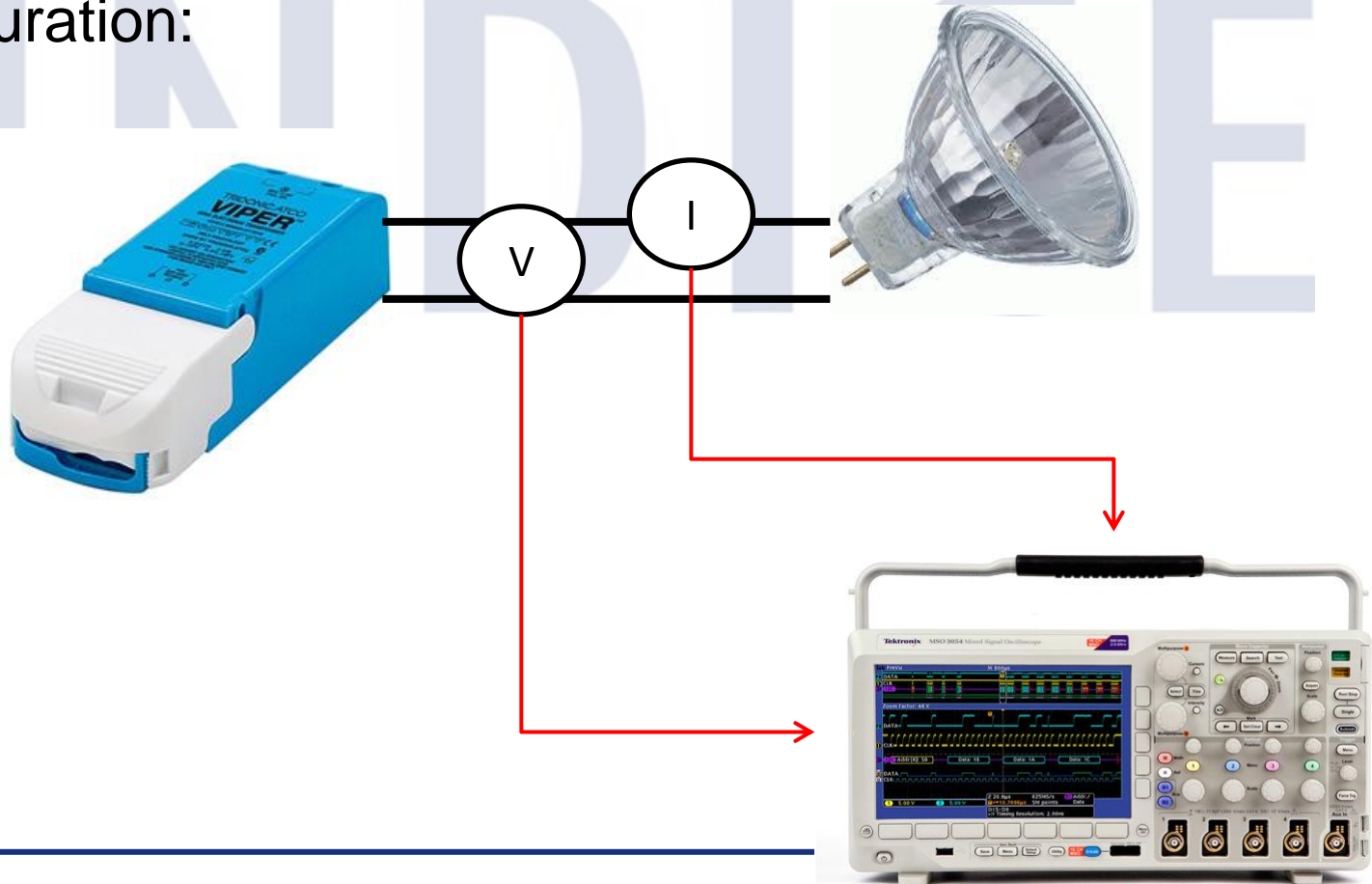


Fig 4: Electronic dimmer example waveform

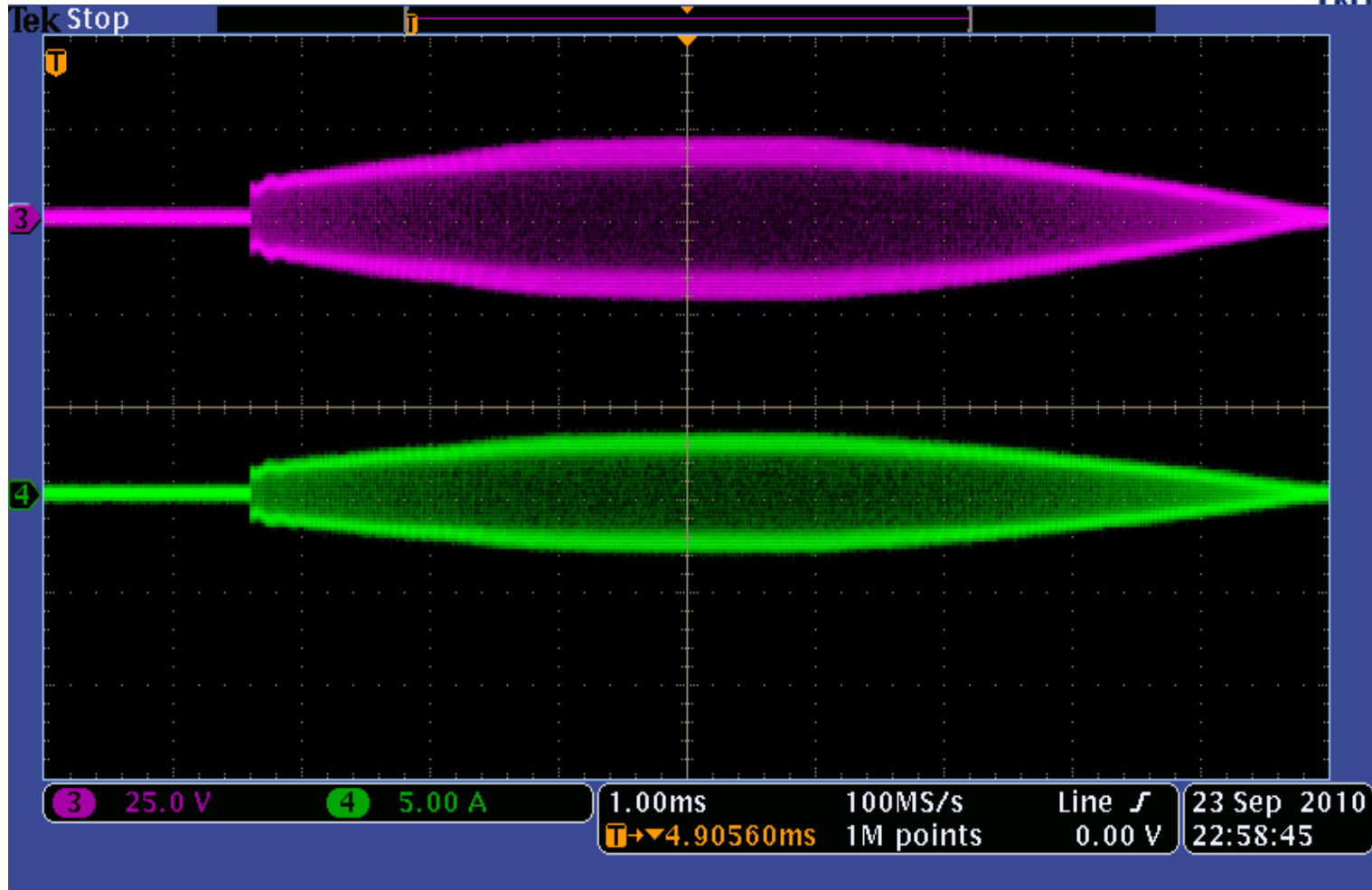
TEST CONFIGURATION



The following slides are measured using the following configuration:



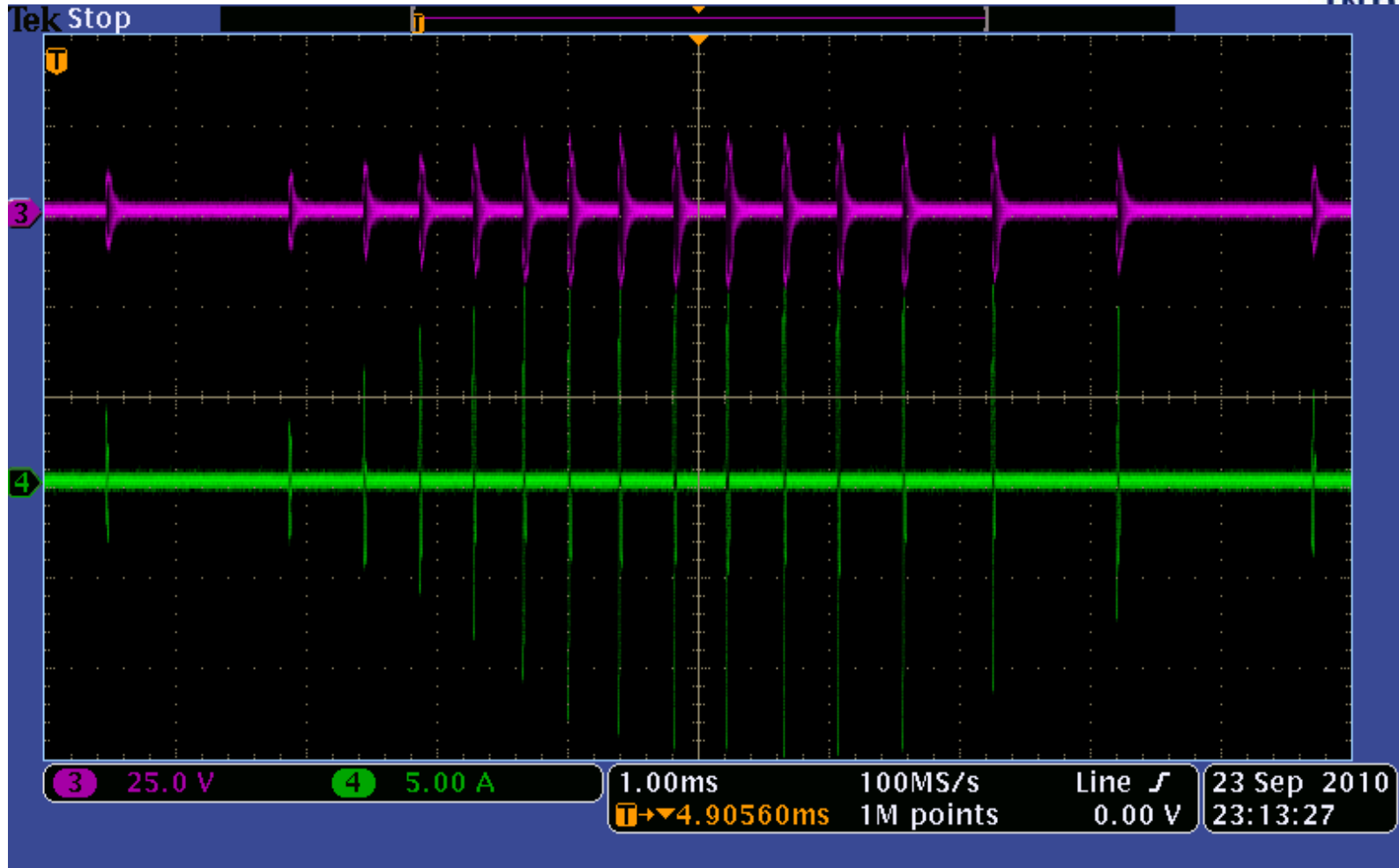
20W HALOGEN SINGLE CYCLE



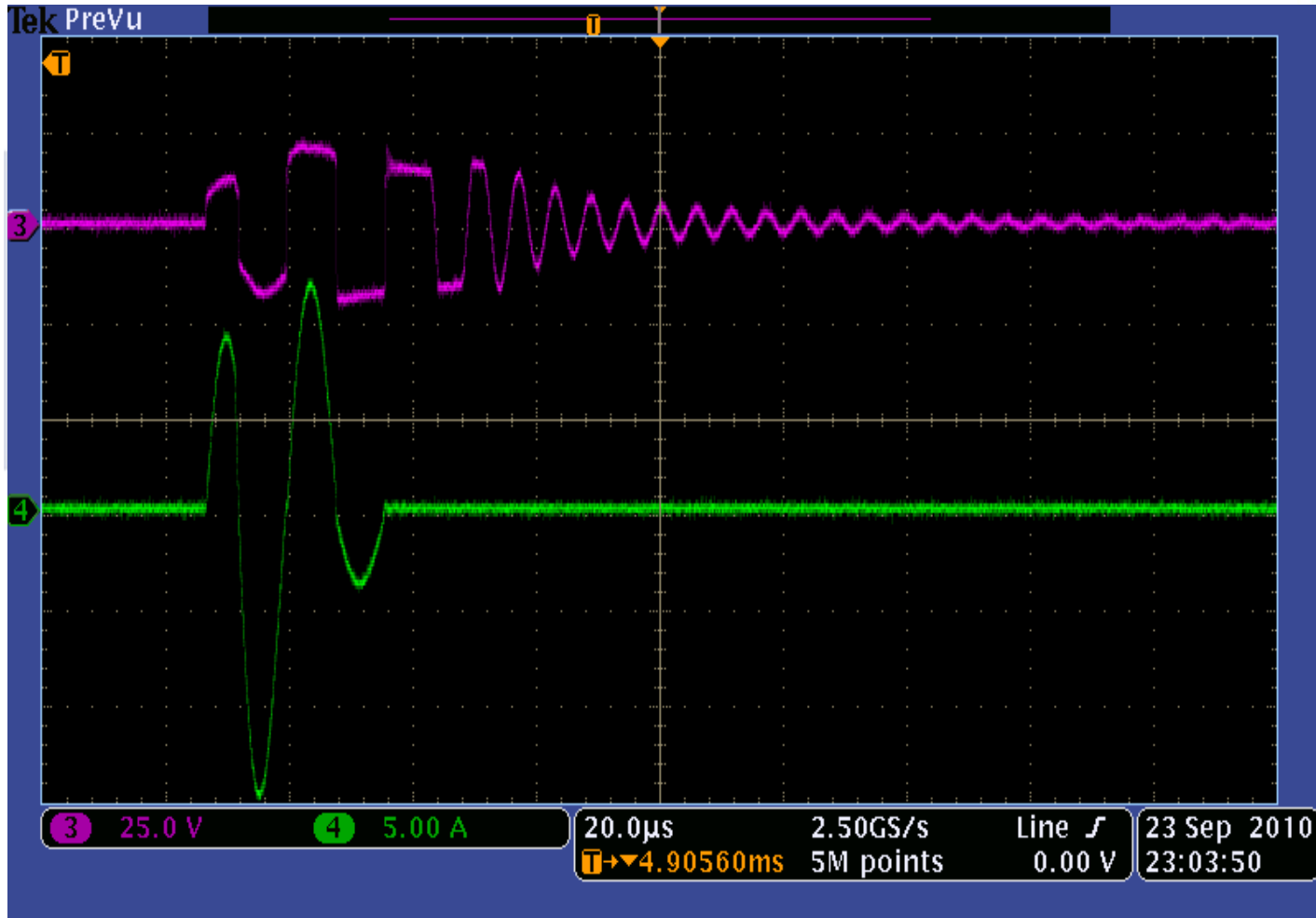
20W HALOGEN INVERTER RESPONSE



TYPICAL LED SINGLE CYCLE



TYPICAL LED INVERTER RESPONSE

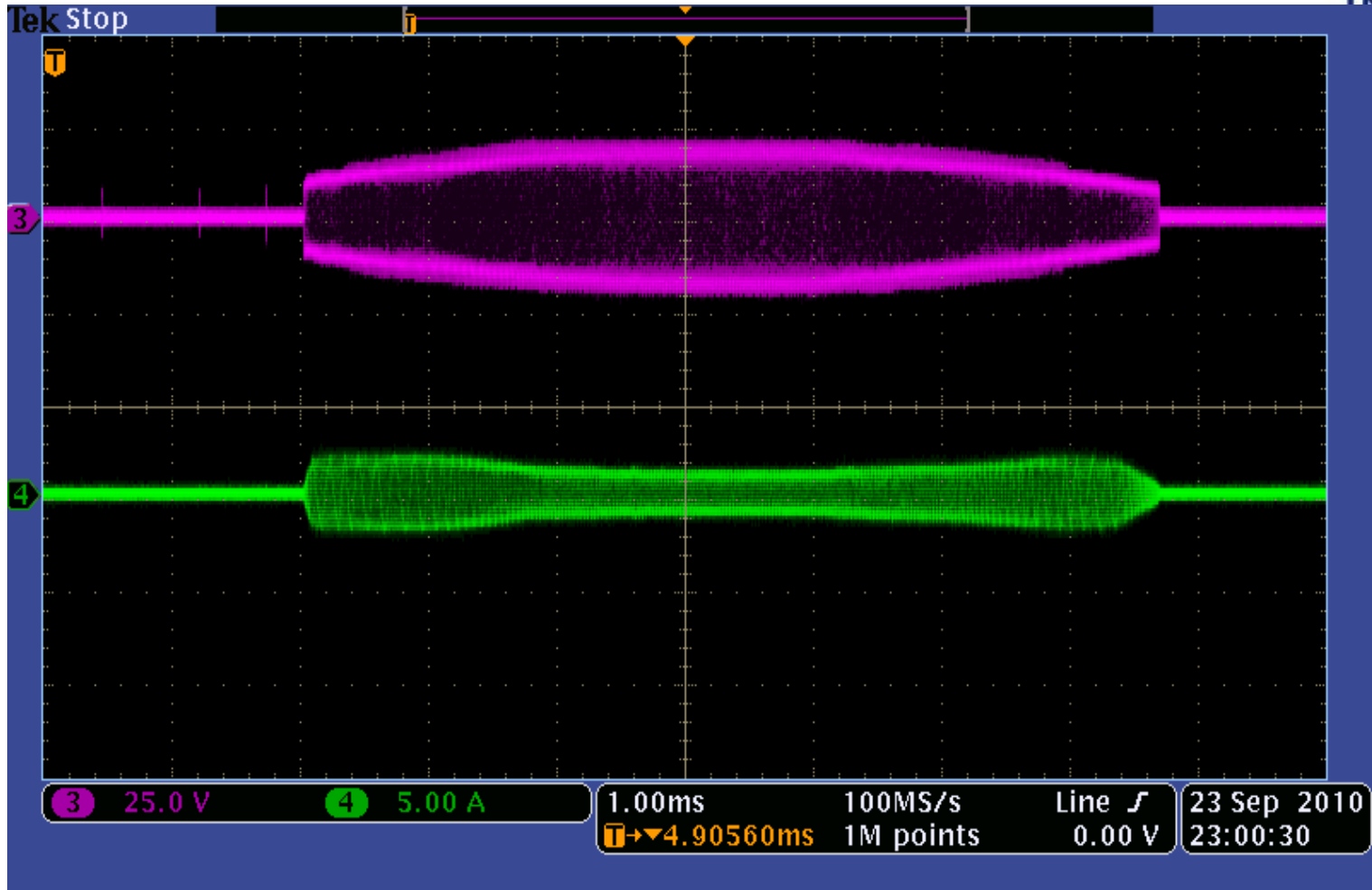


THE INDICE APPROACH

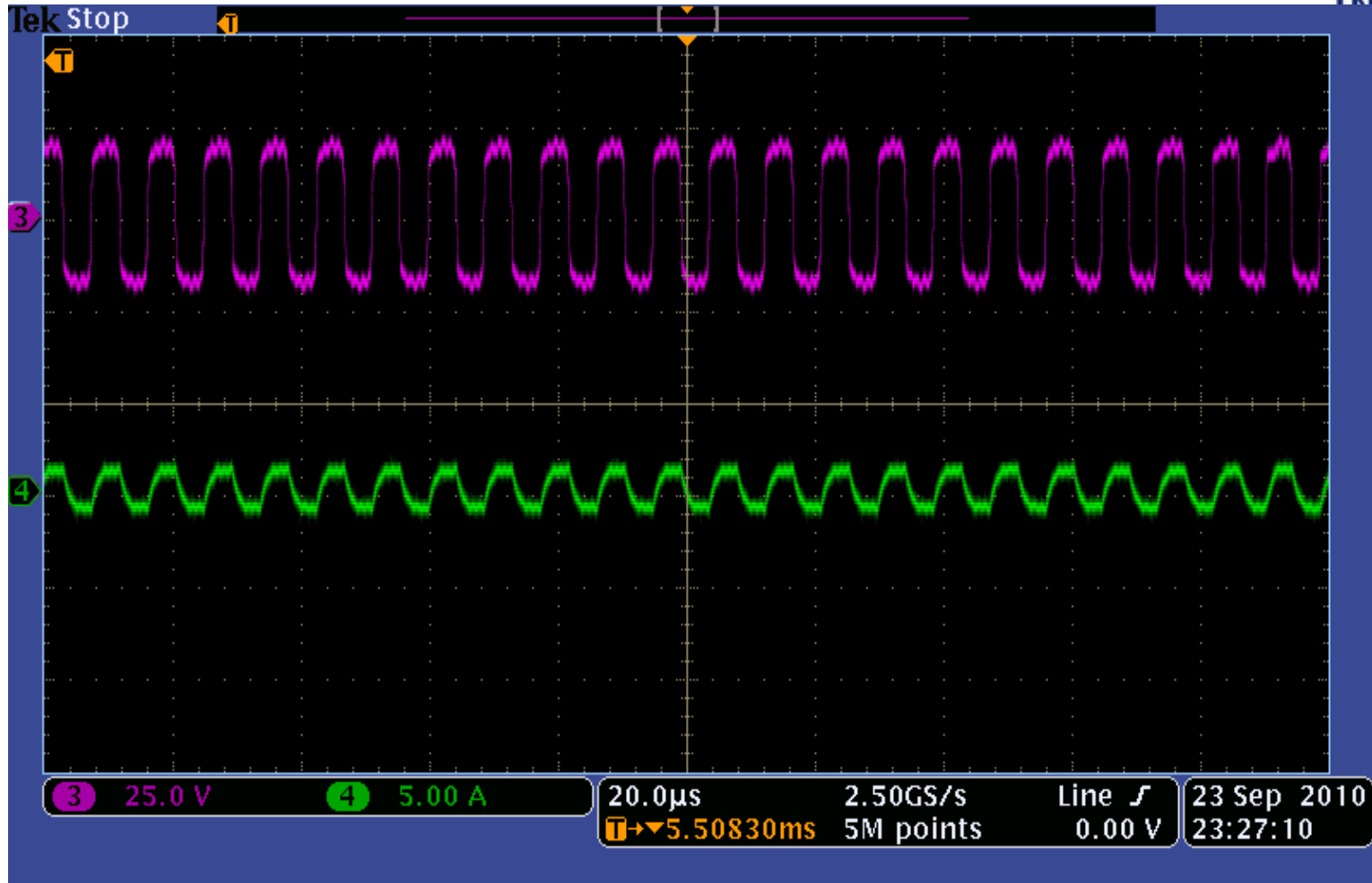


- Managing the power source is just as important as regulating the load. Boosting provides a ‘Virtual load’ to the electronic transformers.
- Traditional synchronous boosting is inadequate as they cannot adapt to the changing input waveform in realtime.
- Indice’s control scheme is a cycle by cycle, asynchronous control scheme based on AI neural nodes. This allows primitive decision making to occur at speeds in the megahertz using cheap available hardware.

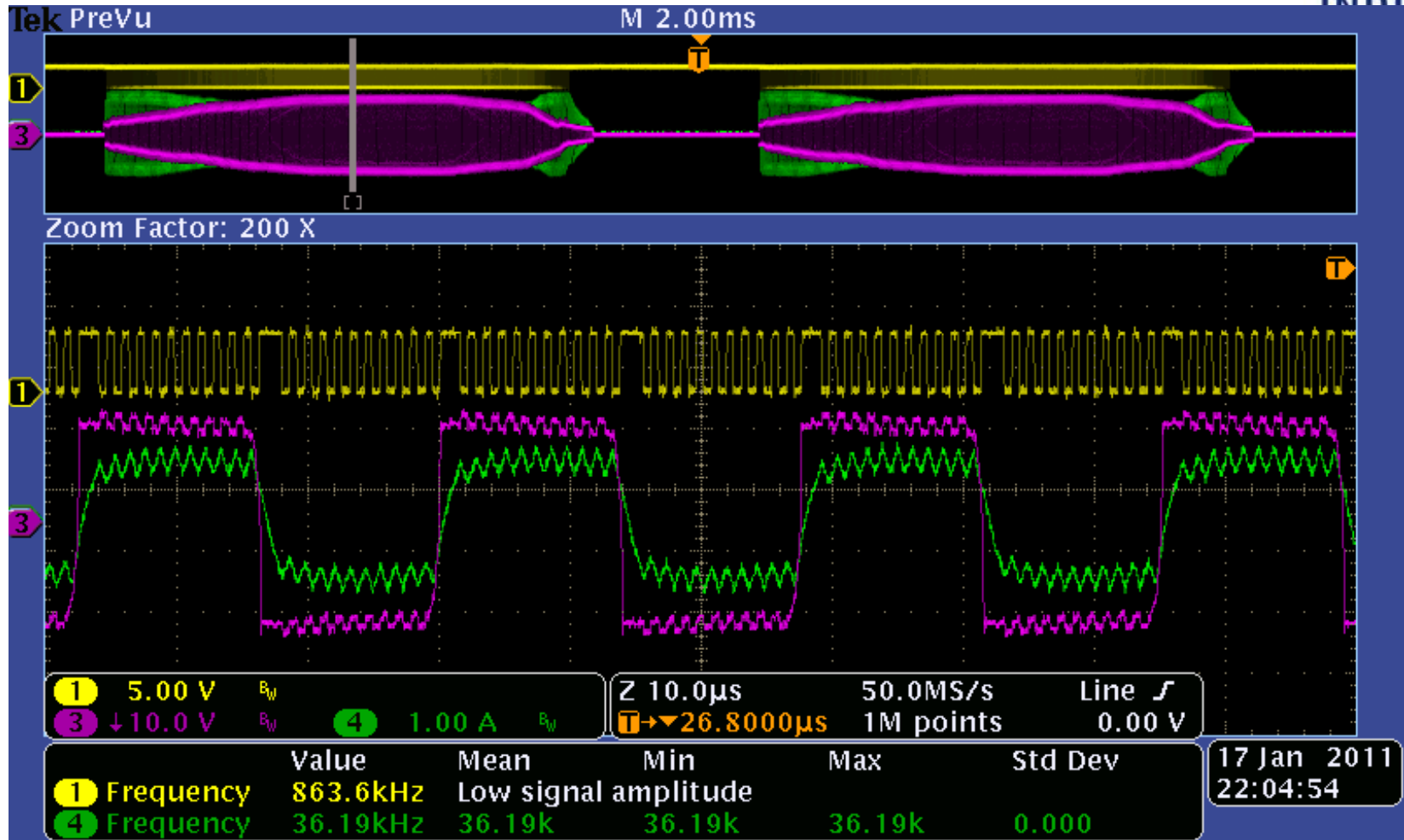
INDICE DRIVER SINGLE CYCLE



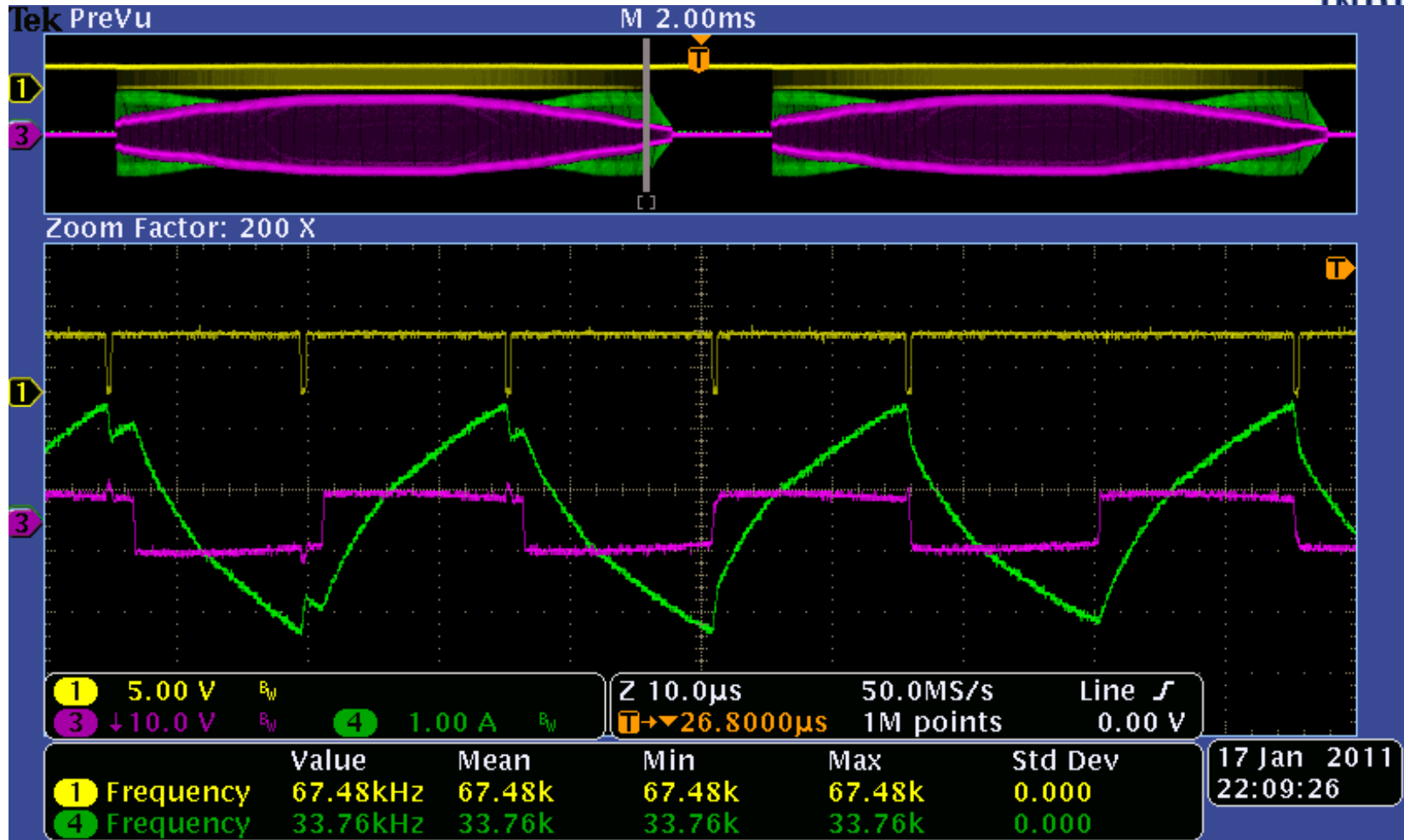
INDICE DRIVER INVERTER RESPONSE



INDICE DRIVER RESPONSE WITH FET DR



INDICE DRIVER RESPONSE WITH FET DR





INDICE TECHNOLOGY BENEFITS

- True dimming and transformer compatibility
- Fully compatible with 3 – 40V LED arrays
- EMC Compliant
 - CTICK, FCC and CE compliant
- Power factor of 0.8 to 0.95 on most transformers
 - meets Energy Star
- Control board efficiency 80-90% (including EMC circuitry)
 - electronic and magnetic transformers
- Asynchronous operation
 - up to approximately 2 MHz burst with very ordinary components
- Active temperature control
 - lamp running power will adjust automatically to match the ambient air temperature
 - prolongs operational life
- Complete reference design provided to lighting customers
- Cost effective

PART NUMBERS AND EVALUATION KITS



LED Driver IC Part Number

Type of LED Driver IC	Part Number	Description
Low voltage LED Driver IC	INDICE0002	LED Driver IC for MR16 / AR111
Line voltage LED Driver IC	INDICE0101	LED Driver IC for Mains (110/230V)

LED Driver Evaluation Kit Part Numbering:

Part Number	Description
EVAL01-MR16	3x 7.5W Medium MR16 LED lamps + 20pcs INDICE0002 LED Driver IC
EVAL11012W	110V Mains Evaluation Kit
EVAL24014W	240V Mains Evaluation Kit

Where to buy:

www.futureelectronics.com

www.indicesemi.com

EVALUATION BOARD PART NUMBERING



Driver Board part numbers are determined in the following way:

	XX	-	XXXXX	-	X	XX	XX	XX
Example 1:	IN	-	AR111	-	D	14	RD	12
Description:	Indice Product		Application Type		Single/Dual Stage Driver	Driver Power (W)	Board Configuration	LED Voltage (Vf)
Example 1 P/N:	IN-AR111-D14RD12 = Indice AR111, Dual Stage, 14W Round Board, 12V LED Voltage							
Example 2 P/N:	IN-MR16-S06SQ27 = Indice MR16, Single Stage, 6W Square Board, 27V LED Voltage							
Example 3 P/N:	IN-M240-S18RT36 = Indice 240V Mains, Single Stage, 18W Rectangular Board, 36V LED Voltage							

Note:

Dual stage drivers are required when the LED forward voltage is less than 20V.

Customers looking for the optimum size and cost solution should strongly consider single stage drivers.