Coupled Diode Discovery Protocols and Prototypes

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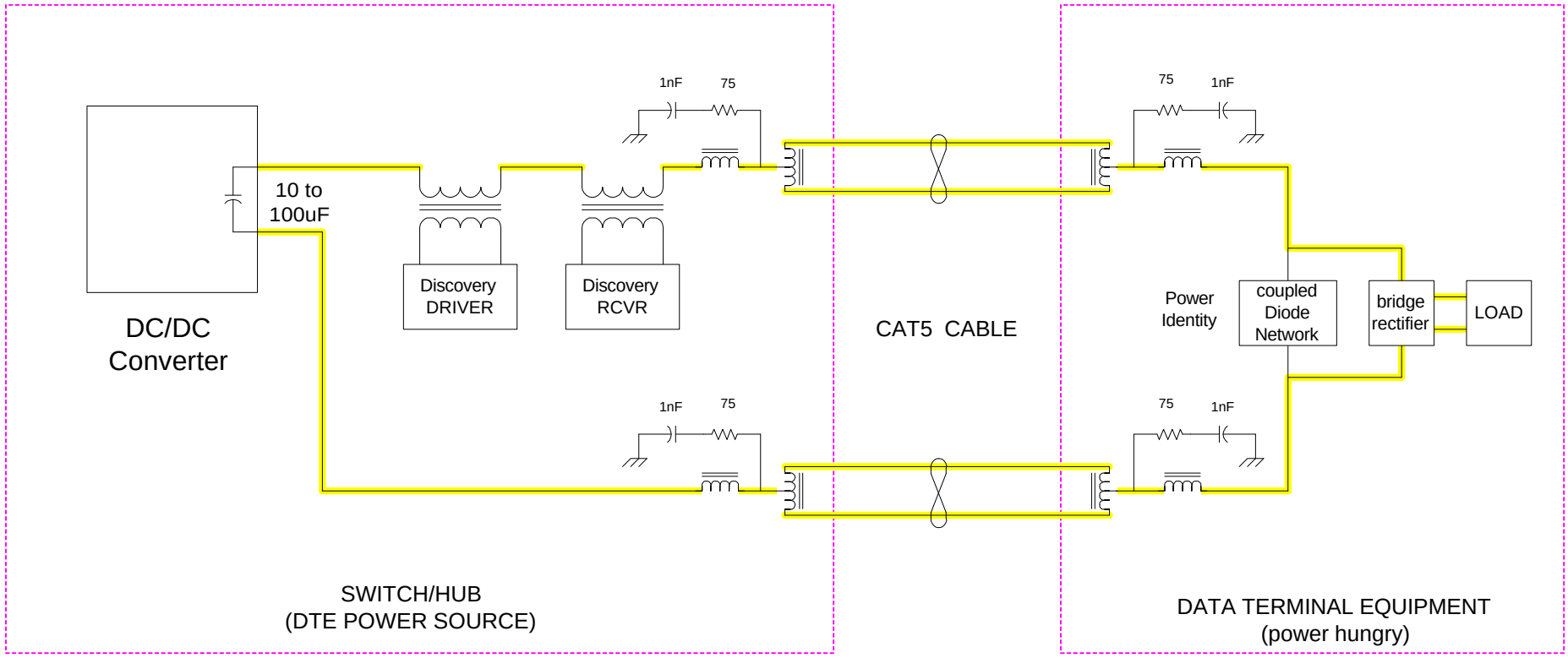
Discovery Process Goals

- **identify appropriate power hungry devices**
- **identify cable and connection problems**
- **avoid powering legacy equipment**
- **minimize the probability of a false detection**
- **provide a robust system solution**
- **practicable at a relatively low cost**
- **allow transparent use of straight and crossover cables**
- **enable powering without the need for management**
- **allow for the use of multiple DTE power sources**
  - want to be independent of power sequencing
  - discovery method needs to be independent of data transmission

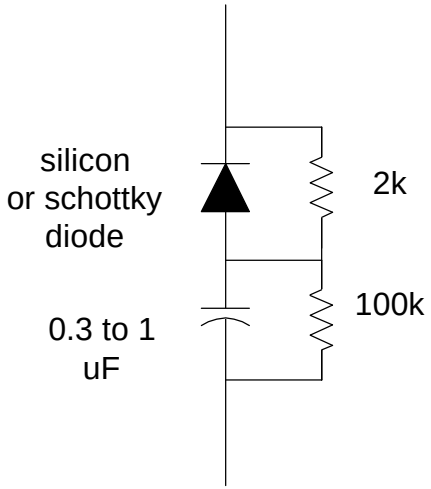
Common Mode Discovery Block Diagram

- uses an AC coupled diode network for polarity sensitive detection
- transformer coupled common mode technique provides 2200 VDC isolation
- pulses and synchronous detection are digitally controlled,
- pseudo random idle spaces are used: lower radiated emissions, harder to fool



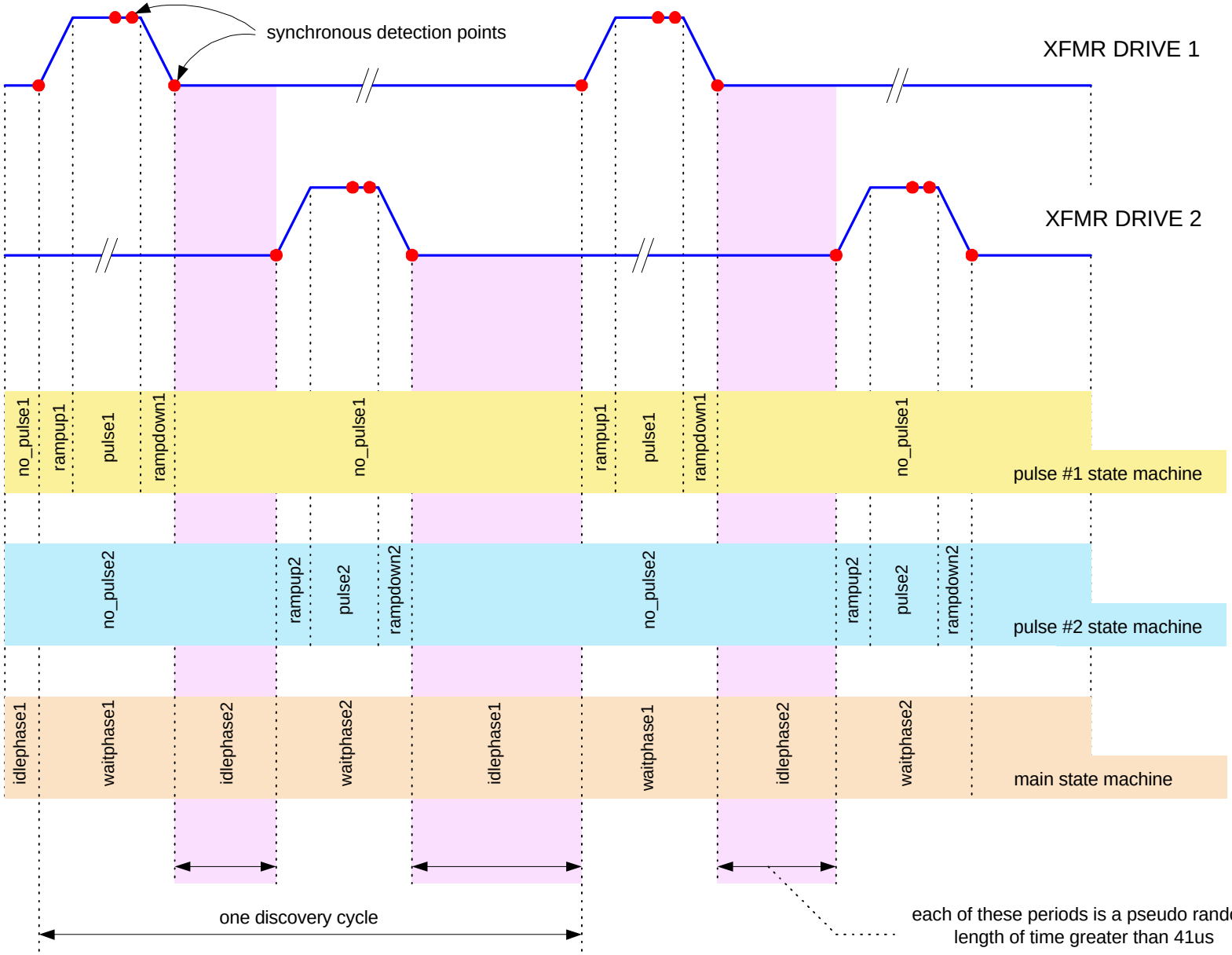
Common Mode Discovery, coupled diode network

- **Diode detection modified to allow either polarity of DTE power**
- **allows for low voltage, polarity sensitive discovery using low duty cycle 5us pulses**
- **with high duty cycle discovery pulses, can be made to look like an open circuit**
  - provides a higher level of discovery confidence
- **becomes high impedance at +/- 48 VDC**
  - resistors can be small size, or integrated
- **easily handles 48 volt transients (intermittent contacts, etc…)**



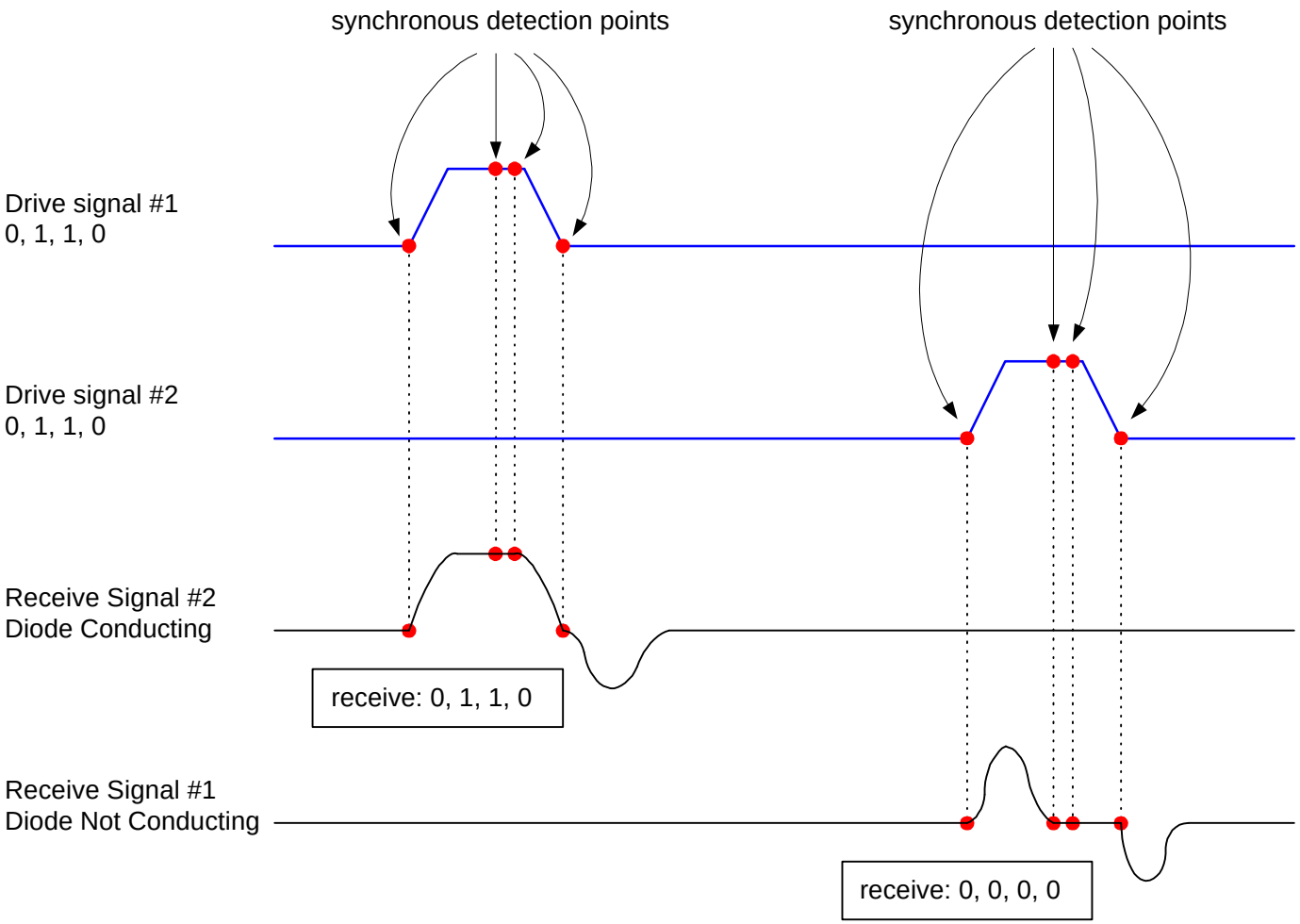
AC coupled diode network

General timing during discovery phase

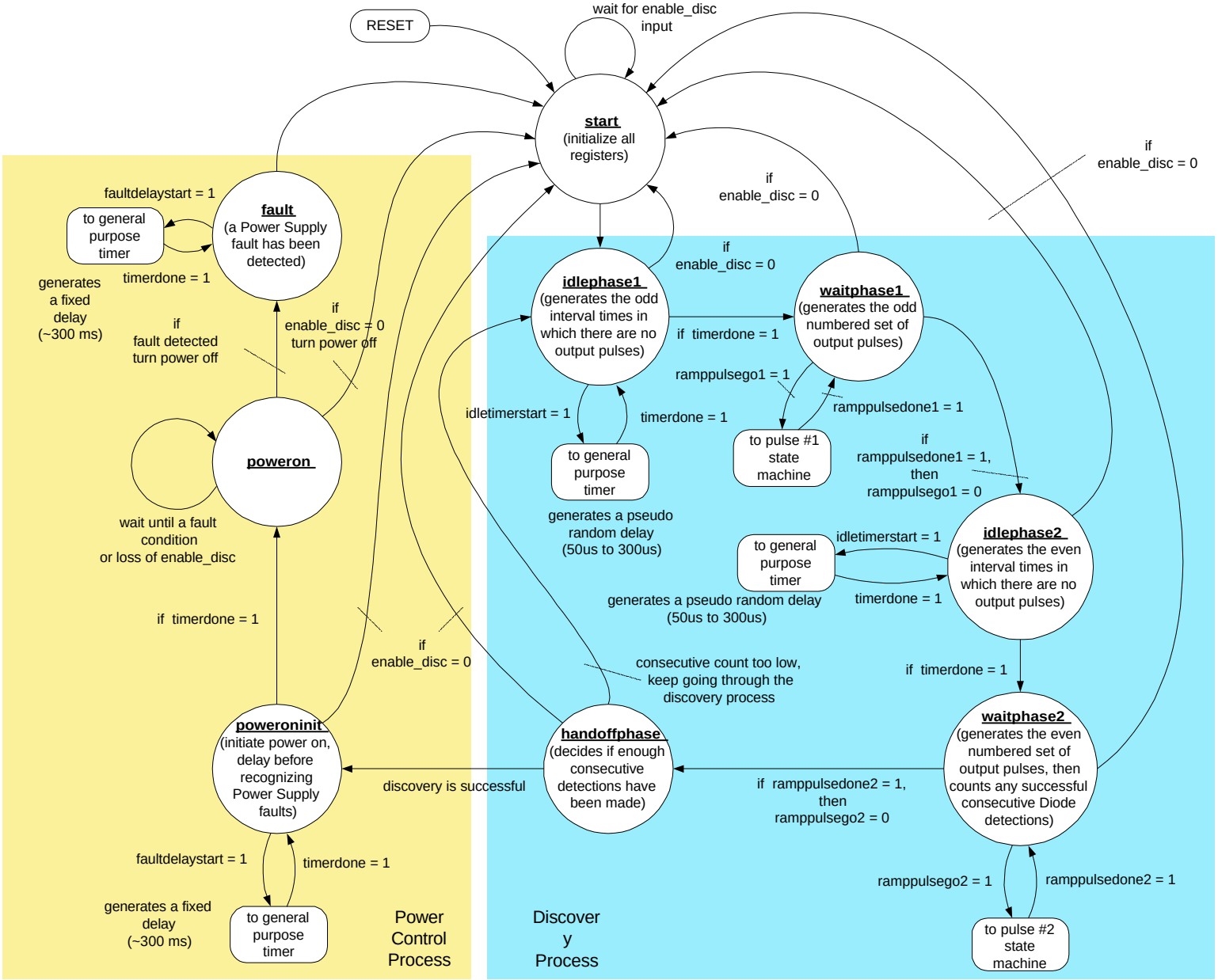


Synchronous Detection Scheme

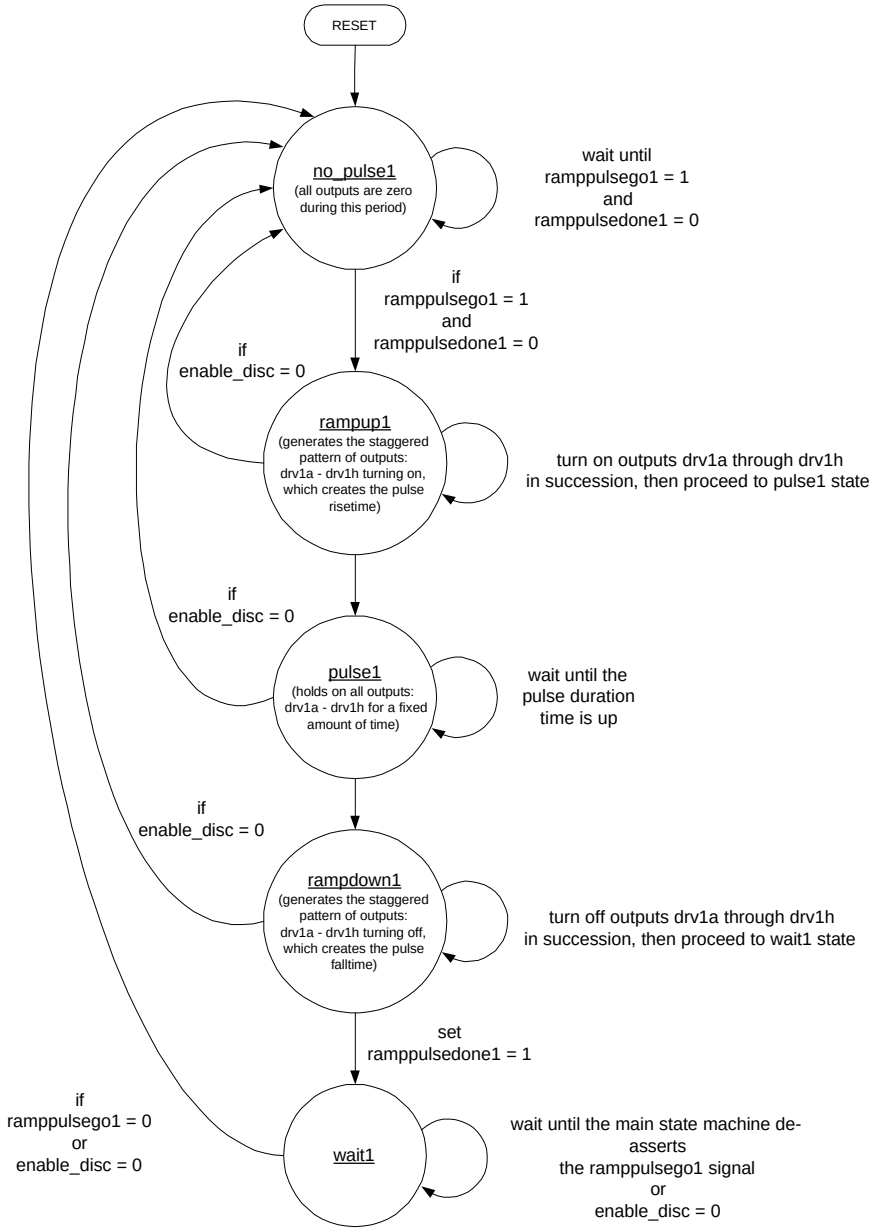
- **Discovery requires a set of consecutive successful discovery cycles**
  - the prototype requires 256 consecutive discovery cycles



Basic Flow Diagram, Discovery and Power Control Protocols

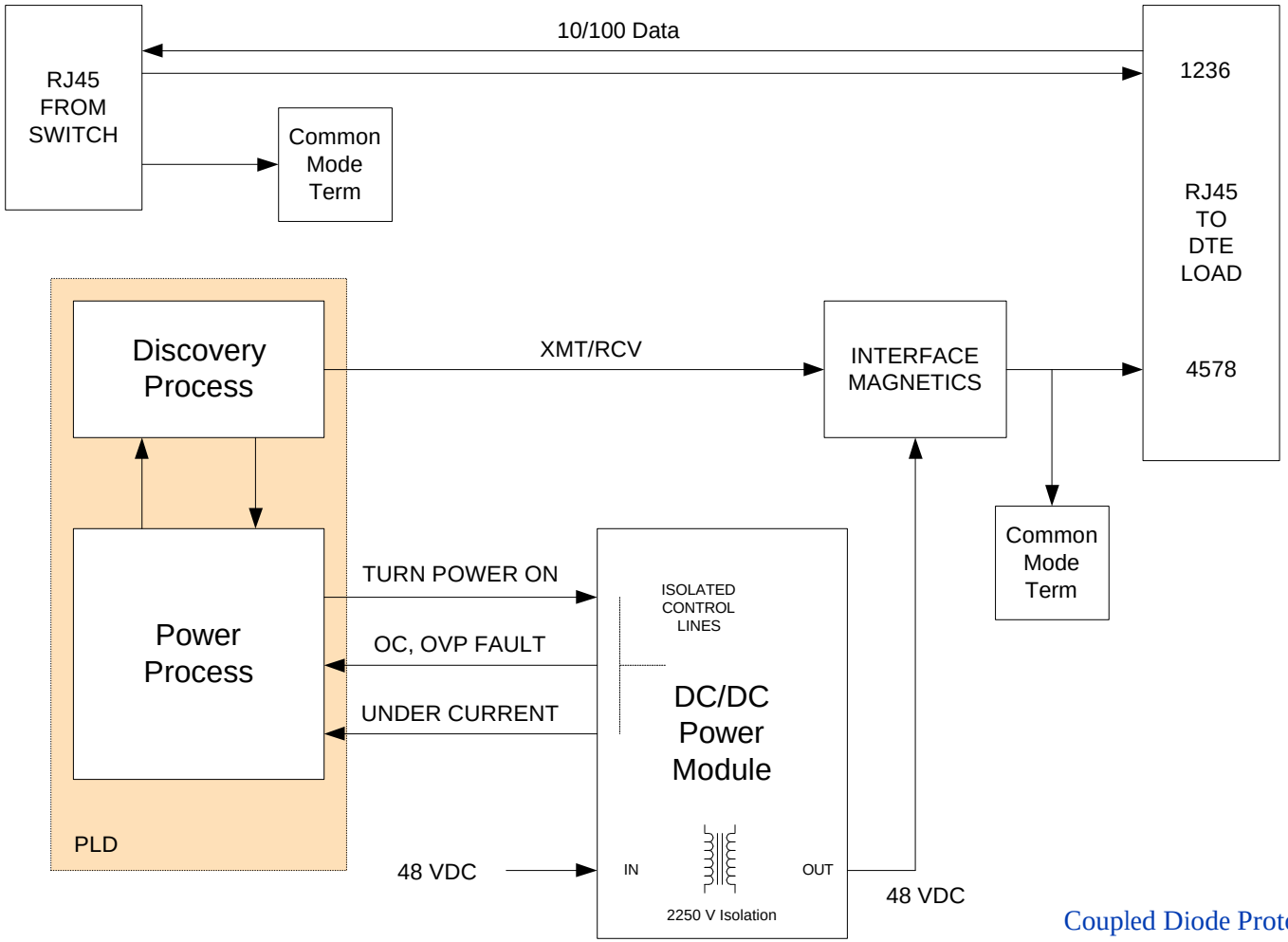


Typical Discovery Pulse Generation Protocol

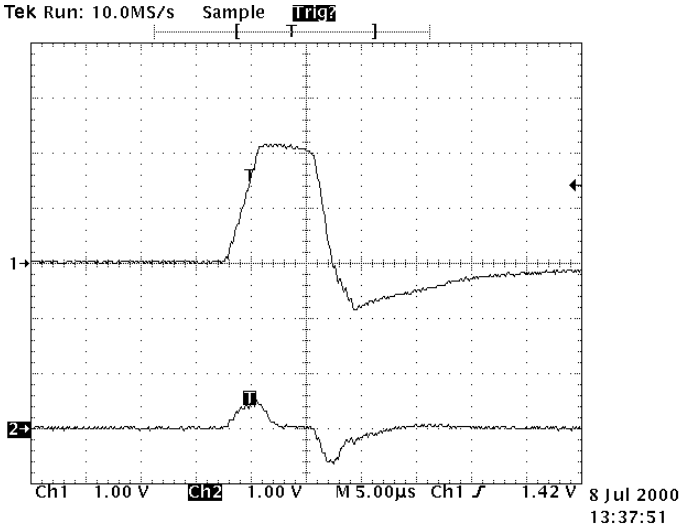


Midspan Power Insertion Prototype Block Diagram

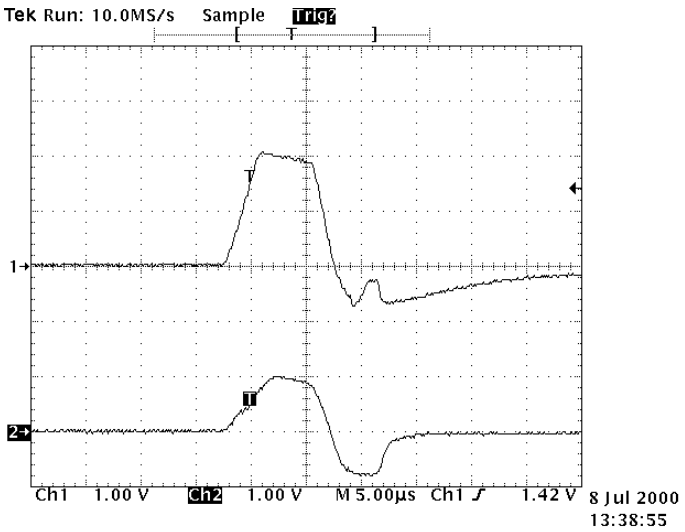
- **Prototype finds powerable DTE devices and automatically powers them**
- **Midspan configuration for power insertion, can be used to put power on an existing link**
- **48VDC/48VDC isolated power module with status and control signals**
- **Verilog code implemented in a PLD for discovery and power control**



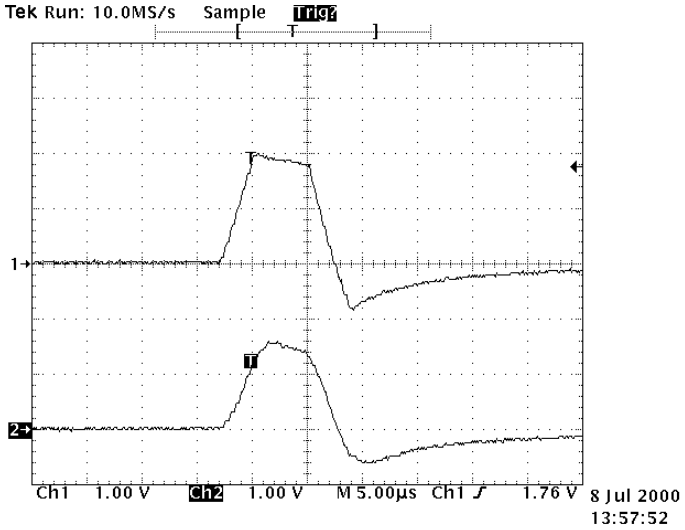
Midspan Prototype Measurements, 120 meter CAT 5 cable



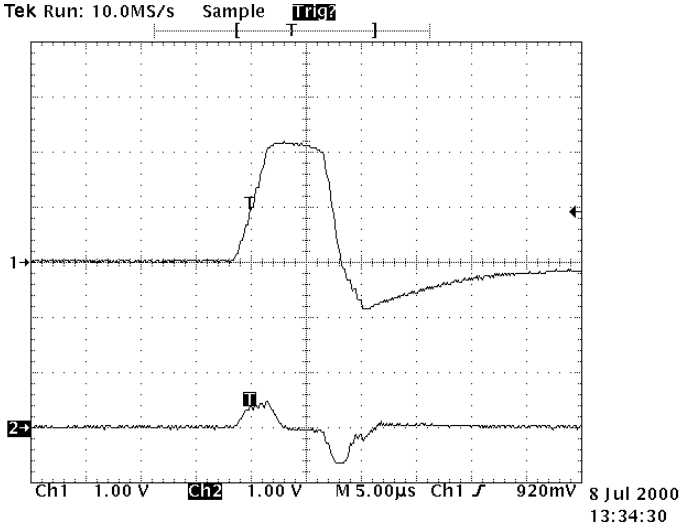
diode non-conducting direction



diode conducting direction

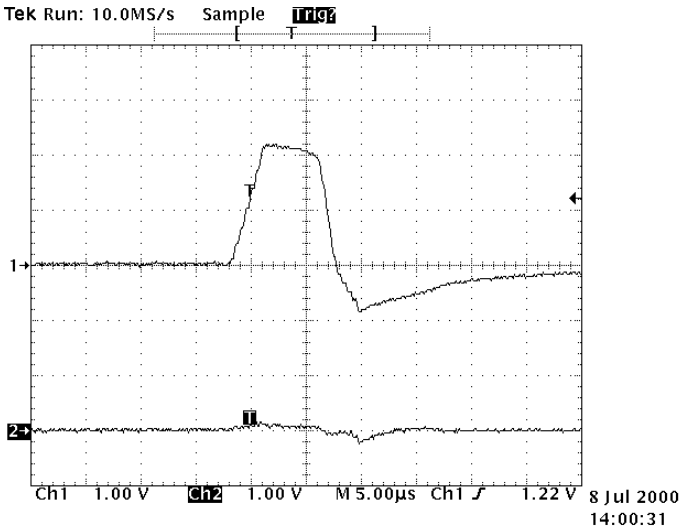


shorted load

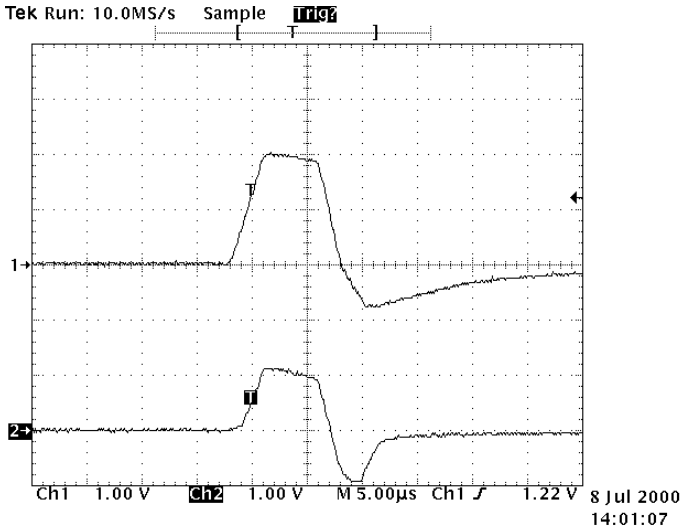


open load

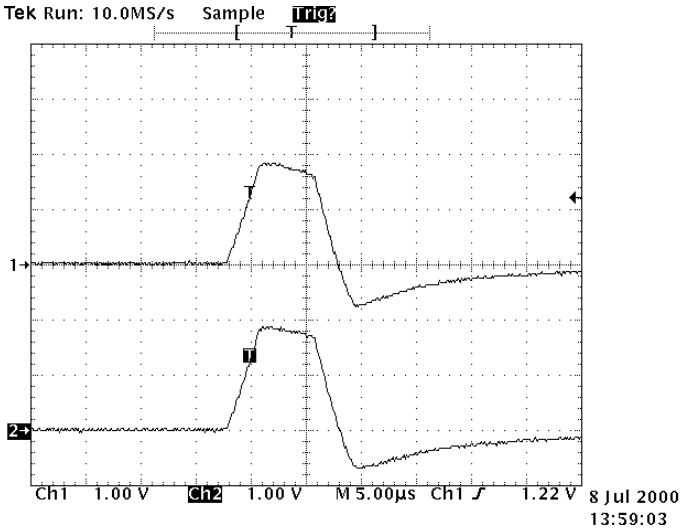
Midspan Prototype Measurements, 1 meter CAT 5 cable



diode non-conducting direction



diode conducting direction



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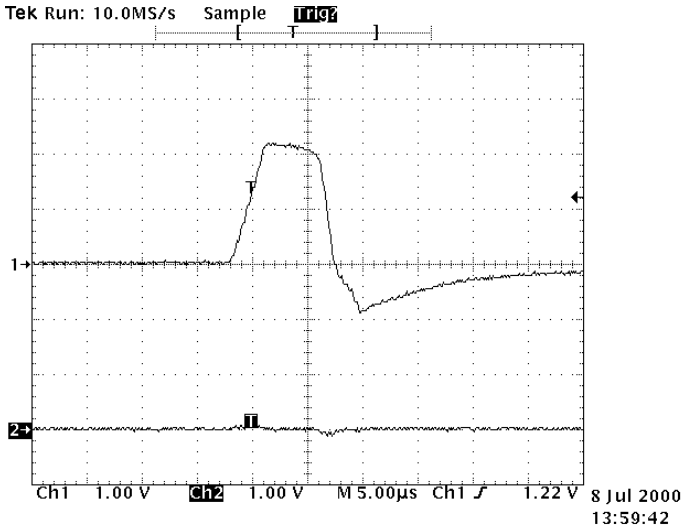

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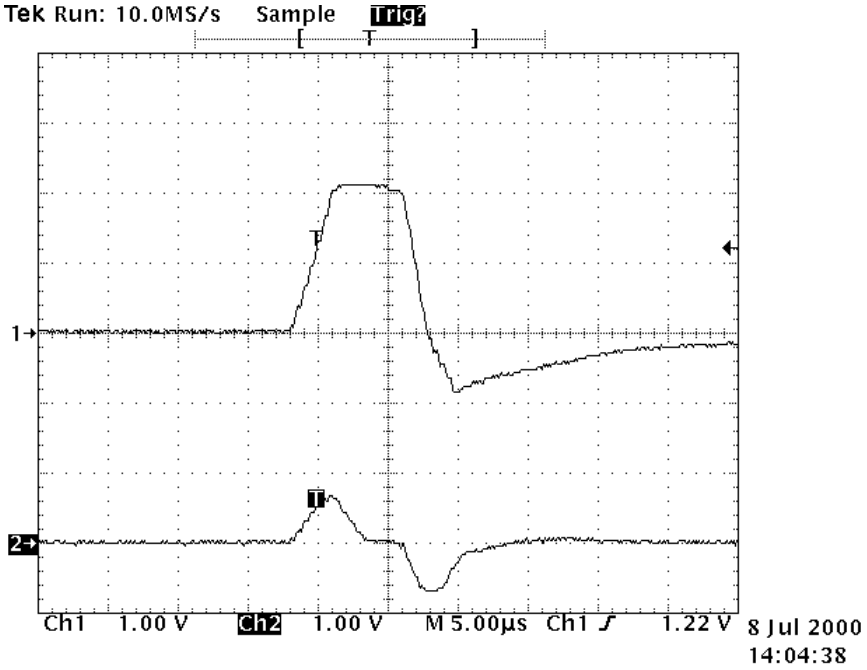
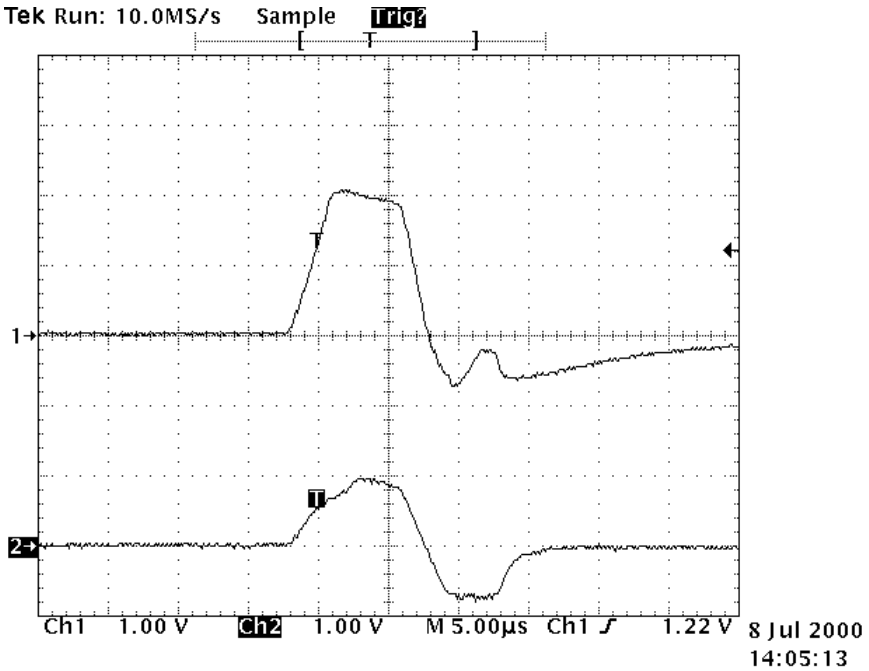
Midspan Prototype Measurements, 181 meter CAT 5 cable

diode non-conducting direction

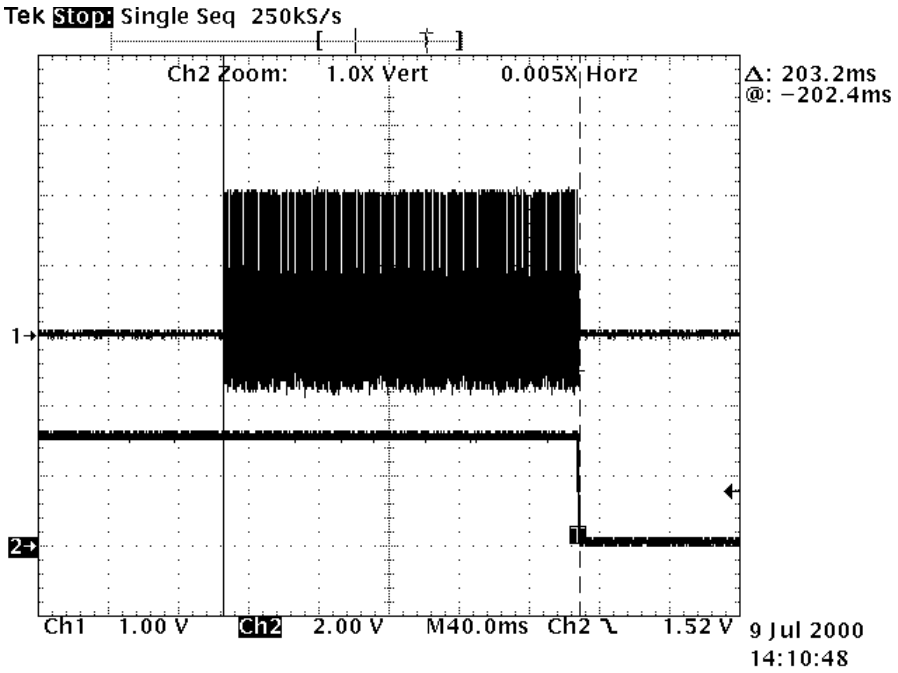


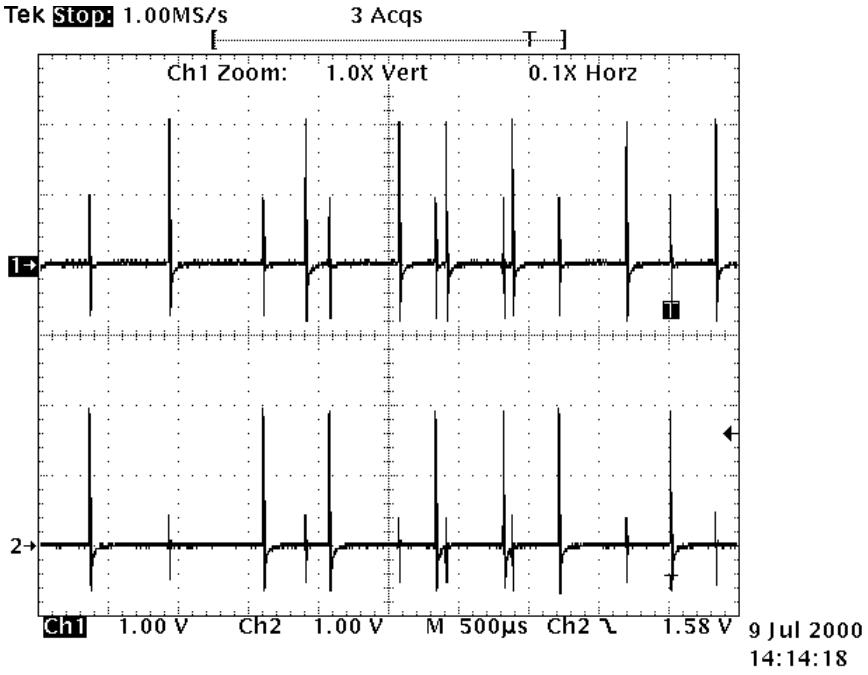


diode conducting direction

Midspan Prototype Measurements - Discovery Sequence

A successful set of 256 consecutive discovery cycles, total discovery time is 203ms, the lower trace is n_turn_power_on





close up of the alternating pattern of drive #1 and drive #2, the higher amplitude pulses are the transmit, the lower amplitude pulses are receive (120m. Cable)

Summary

- **The Midspan prototype demonstrates that the common mode discovery mechanism, using the coupled diode identity performs well for discovery and power control**
  - the digital technique is robust, works with 180 meters of cable
  - automatically powers up when a successful detection is made
  - automatically powers down when the cable is unplugged
  - does not power legacy equipment
  - Verilog code and prototype schematics are available
- **more investigation and testing are needed:**
  - further developments:
    - reduce to single coupling transformer
    - cost reduction: investigate whether the coupling transformer saturation due to DC load current is a viable way of detecting when the cable is unplugged
  - need to do the “three fingers” tests
  - need to see if power and data are really independent from each other
  - need to find if the discovery method can be fooled, ESD, radiated emissions...
  - we are looking for people who are interested in performing some tests, we can provide some more prototypes
- **acknowledgements:**
  - Larry Miller, Robert Muir, Dan Dove, and diode lovers everywhere...