

DTE Power via MDI Discovery Process

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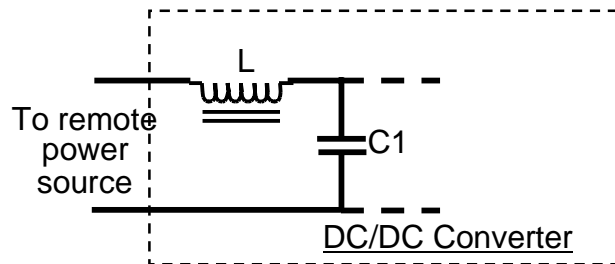
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Basic idea for the discovery process

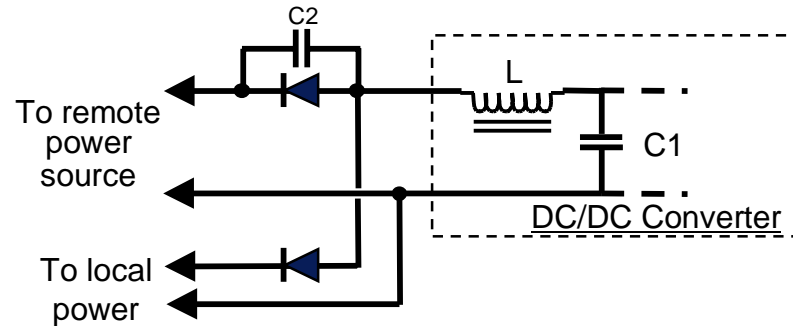
- ▼ The discovery process is based on impedance measurement,
- ▼ The measurement is made
 - ☞ By using alternative and direct voltage
 - ☞ Alternatively or simultaneously
- ▼ To be recognized, and thus powered, a terminal just needs to have a capacitive impedance

Power sink with capacitive impedance

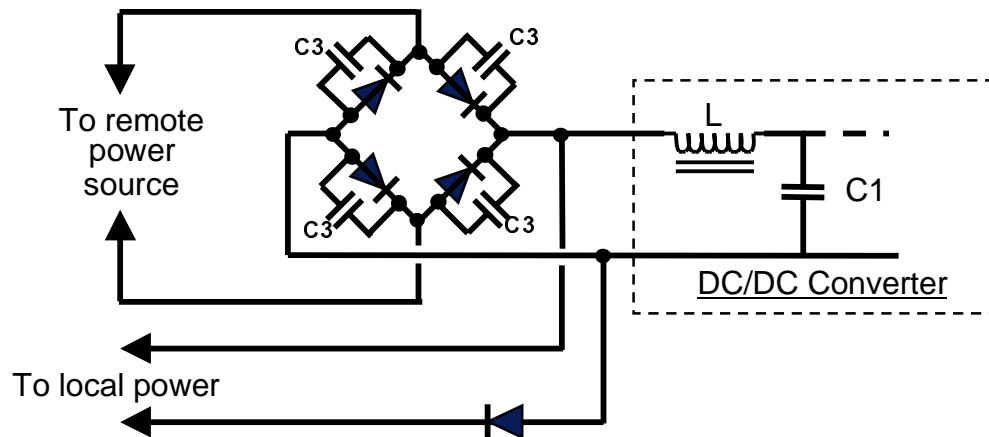
▼ There are 3 examples of power sinks that will be recognized by the discovery process :



Case 1: terminal without local power source



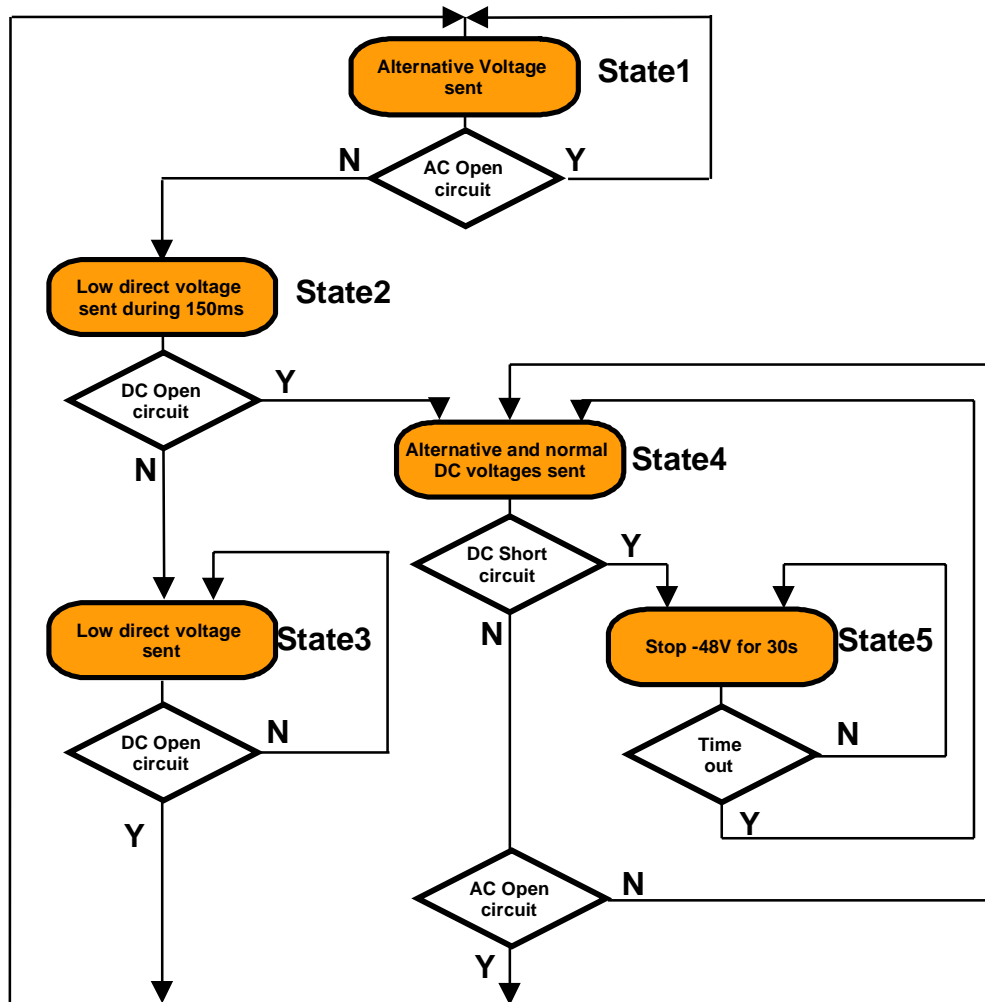
Case 2- terminal with local power & simple protection



Case 3- terminal with local power & protection including possible reverse polarity of the remote power

- ▼ **The values of capacitor are the following:**
 - ☞ **C1 is the capacitor naturally used when carrying out a DC/DC converter, its value is generally greater than 50uF**
 - ☞ **C2 = 2uF/63V**
 - ☞ **C3 = 4uF/63V**

- ▼ **With these values the AC impedance of the power input is less than 10 Ohms with a 5kHz frequency**



State 1 : Initial state. A 5kHz frequency is sent on the track which will be used to sent the power. As long as an AC open circuit is detected the state machine loops there. When another impedance is detected then state machine goes to state 2. Other impedances can be : short circuit, Bob Smith termination, capacitor, etc...

State 2 : In this state a low DC voltage (5V) is sent on the same track as previously. If a DC open circuit is detected, state machine goes to state 4. This is the case when a capacitor is detected (since under AC voltage it was not an open circuit). If any other impedance is detected that means it is not a capacitor. Other impedances can be Bob Smith termination, short circuit on the link or in the terminal, etc... In case of other impedance state machine goes to state 3.

State 3 : In this state a low DC voltage (5V) is still sent in order to wait for detection of a DC open circuit meaning the terminal has been disconnected, or the short circuit removed. In that case state machine goes back to state 1.

State 4 :In this state the power DC voltage is sent (48V), together with an alternative voltage over DC voltage. State machine stays in this state as long as no DC short circuit and no AC open circuit are detected. If an AC open circuit is detected that means the terminal has been disconnected and then state machine comes back to state 1. If a DC short circuit is detected that means either a problem occurred in the terminal or a short is suddenly present on the link; in this case state machine goes to state 5.

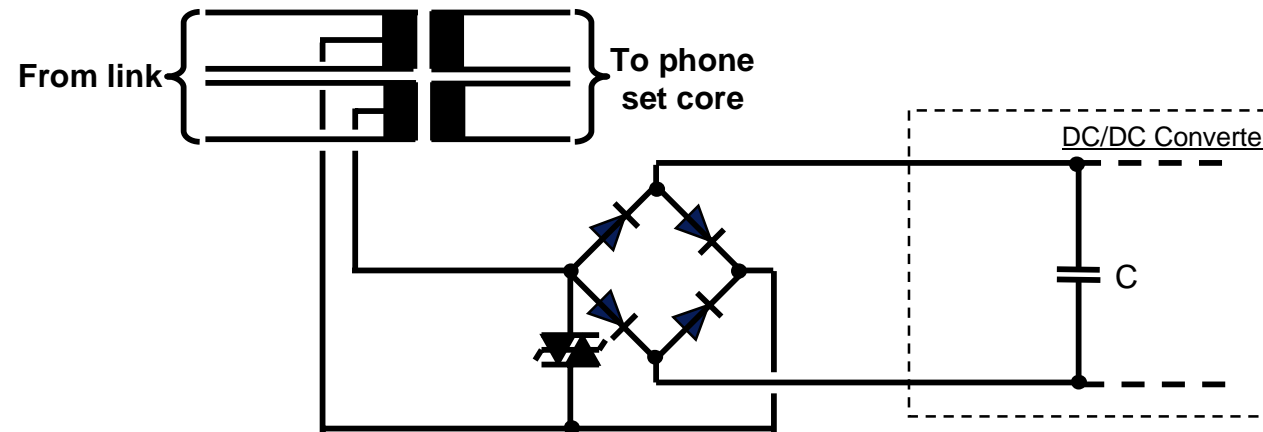
State 5 : In this state the power is held off during a timer (30s for instance). After the time out state machine comes back in state 4.

Cases covered by the discovery process

▼ This state machine is able to detect the following cases :

- ✎ A legacy equipment is connected to the link : Power is not sent.
- ✎ A terminal to be powered is connected to the link : Power is sent.
- ✎ A terminal was powered, and is unplugged: power emission is stopped and discovery mechanism starts again (the terminal might be replaced by another one, not requiring remote power)
- ✎ A terminal was powered, and short circuit is detected: power emission is stopped
- ✎ A terminal to be powered is connected to the link, and it is already locally powered : Power is sent and will be put off if, and only if the terminal is disconnected. Together with battery backup at the remote power source, this makes it possible to feed the terminal in case of mains shut down.
- ✎ Two types of terminal are connected in parallel on the link, a terminal to be powered and a terminal not to be powered : power is not sent.
 - in state 1, the process does not detect an AC open circuit and therefore goes to state 2
 - in state 2, the process does not detect a DC open circuit (since there is a resistive termination in the terminal not to be powered).
 - It will then jump to state 3, and will stay in this state as long as the resistive impedance is present on the link.
 - Note: this is true whatever the number of terminals to be powered and the number or terminals not to be powered are being put in parallel.

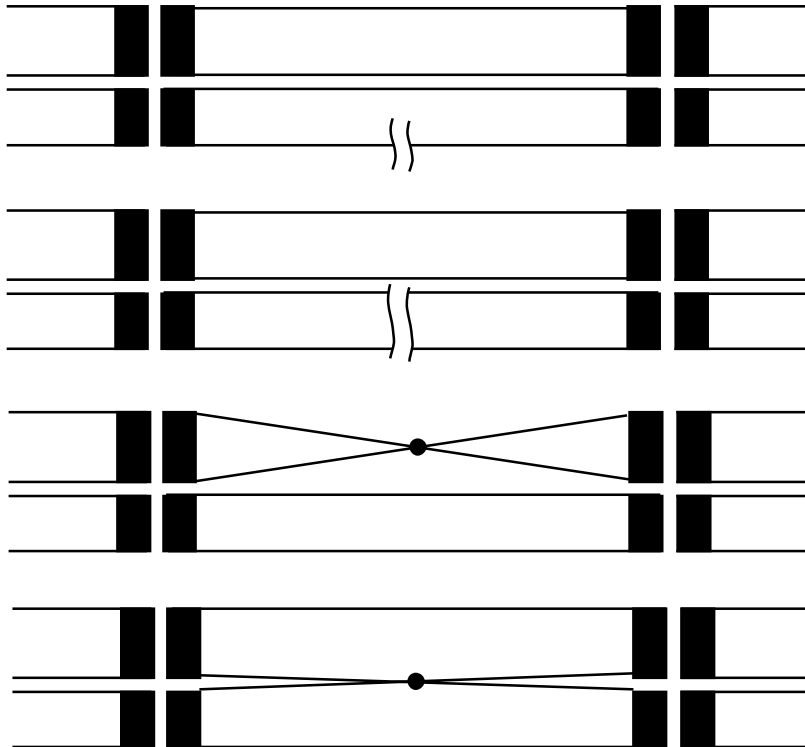
▼ Input of such a phone set :



- ▼ If an ISDN phone set is, by mistake, connected to a powering equipment : the power will not be sent.
- ▼ Indeed, when alternative voltage is sent, the capacitor at the input of DC/DC converter is quickly loaded and then an AC open circuit is detected ==> power is not sent.

This might happen on the link ...

▼ What does it happen when a problem occurs on the link?



Case 1 : One wire (Whatever the wire) of the link is cut. In such a case power is sent without any consequence on the terminal or switch lives. The problem should be detected at transmission side.

Case 2 : Two wires (of the same pair) of the link are cut. In such a case power is not sent since an AC open circuit is detected in state 1.

Case 3 : A short circuit between two wires of the pair of the link. In such a case power is sent without any consequence on the terminal or switch lives. The problem should be detected at transmission side.

Case 4 : A short circuit between two wires of two different pairs. In such a case power is not sent since in state 2 there is no DC open circuit detected.

▼ Any case, any combination of cases can occur, without any bad consequences for terminal or switch lives.

- ▼ **The proposed solution for the discovery mechanism mixes analog and digital parts:**
 - ✎ **The digital part is the state machine: it can be very easily carried out in silicon of the Ethernet chip.**
 - ✎ **The different “detectors” constitute the analog part. Only three detectors are needed, two mandatory and one optional or “nice to have”:**
 - the first one detects AC open circuit,
 - the second one detects DC open circuit,
 - the last one detects DC short circuit in state 4 (while sending power). It’s left open for the designer to implement or not this
 - ✎ **Since DTE power via MDI is planned to have a large range of application, and will have a wide market, a dedicated analog circuit will for sure be proposed by chip providers.**

▼ Remote power + Discovery mechanism

