YAMAR Electronics Ltd.
Preliminary Description

DCAN500 - CAN over Powerline Communication

The information in this data sheet is preliminary and may be changed without notice.

1. General

The DCAN500 transfers CAN messages over noisy DC Power Line at bitrates up to 500Kbps using the DC-BUS™ technology. The DCAN500 operates as a transceiver for a new CAN physical layer over common DC powerline used for network communication between electronic modules. The DCAN500 eliminates the traditional CAN twisted pair data wires, saves weight and simplifies installation.
The device receives and transmits CAN2.0A/B messages. The arbitration over the DC line is based on the CAN message Identifier's first 11 bits. The data is error protected QPSK modulated with low voltage narrow band carrier, eliminating the EMC generated by the "square wave" CAN data lines.
The DCAN500 implemented in CMOS digital process that requires small silicon area, allowing integration with other customer's CMOS IP such as micro-controllers. The DCAN500 couples to the DC line via capacitor; thus, there is no need for high voltage process used by ordinary CAN transceivers.

This innovative solution allows low cost overall CAN implementation, combining power and data over the same cable, withstanding the hostile DC lines impulse noises.

Main Features

- CAN *A/B protocol Communication over DC power line*
- *Bit rates of up to 500Kbps*
- *Built-in Modem, Error Correction and Synchronization*
- *Multiplex CSMA/CA arbitration mechanism*
- *Sleep mode for low power consumption*

Main Benefits

- *Eliminates complex harness*
- *Reduces weight and installation time*
- *Robust to power line noises*
- *Increase reliability*
- *Allows flexible network designs*
- *Low cost CMOS Implementation*

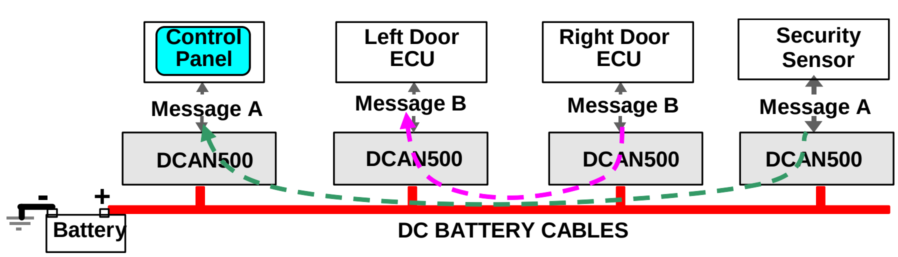

Figure 1 - DCAN500 network example

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2. Overview

The DCAN500 network

The DCAN500 operates as a transceiver in CAN network. Each DCAN500 device can transmit messages to other devices over the power lines according to CAN Controller bit rate (Max 500Kbps). The data on the powerline is phase modulated by a sine wave at a predefined carrier frequency.

DCAN500 Channel parameters

Channel frequency:	5MHz
CAN data transfer rate:	83.3kbps, 125kbps, and 250kbps, 500Kbps (Min DLC of 3)
Cable length:	Mainly depends on the AC impedance @5MHz of loads connected to the powerline.

DCAN500 Architecture

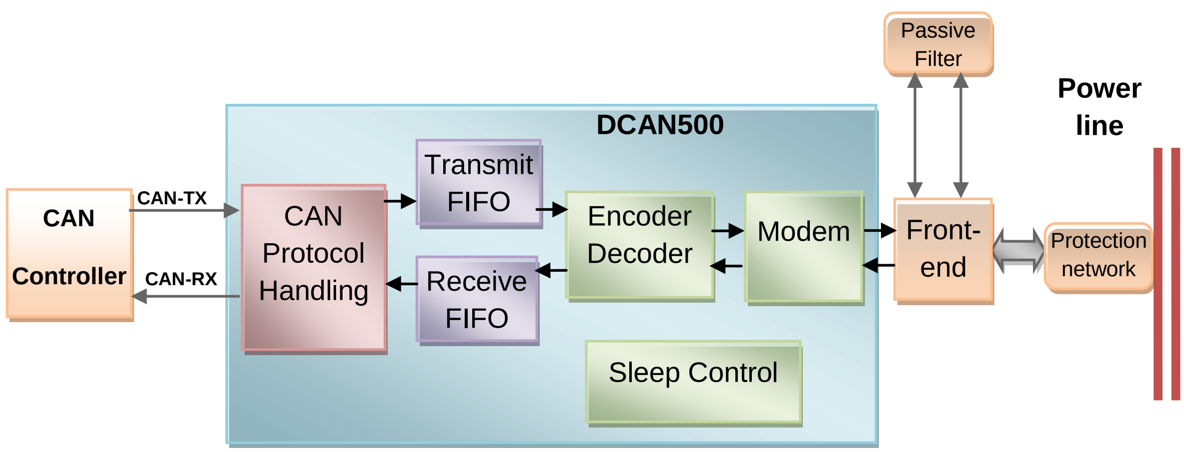

Figure 2 - DCAN500 Block Diagram

The DCAN500 contains the following main building blocks;

- Protocol handling block, interprets the CAN controller protocol.
- CODEC block, ECC encodes/decodes the data.
- Modem block, phase modulates and demodulates the data to and from the DC-BUS powerline.
- CSMA/CA mechanism allow Carrier sense and arbitration capabilities to the device
- Sleep mechanism, ensures low power operation during sleep mode. During Sleep mode, the device wakes up for short period to detect possible wakeup messages from other devices on the powerline.

DCAN500 Frame Structure

The DCAN500 receives a message from its CAN Controller. The CAN message is translated into a powerline-modulated message that includes Carrier Sense, Arbitration bits, Preamble and the message data.

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3. DCAN500 Protocol

The DCAN500 interfaces with the CAN controller. The CAN messages transferred by the DCAN500 over the powerline at the controller configured bit rate; 83.3kbps, 125kbps 250kbps and 500Kbps (Min DLC of 3). All others DCAN500 decode the message from the DC-BUS powerline into CAN message.

When CAN message is received from the controller, the DCAN500 imitates an arbitration sequence based on the message ID. After gaining access to the powerline, the DCAN500 generate an ACK to its controller and the entire message transferred to the powerline. If arbitration failed, the DCAN500 generates NACK response to its CAN controller and returns to idle state.

Upon receiving a CAN message from the DC line, the DCAN500 corrects the message from line errors and transfer it to its CAN controller.

3.1 Bit rate automatic learning

Upon reset, the first CAN message from CAN controller is used to teach the DCAN500 the CAN bit rate. The DCAN500 will learn the bit rate and **will not send this message over the powerline nor respond with ACK to this message.**

Following messages from CAN controller are transferred over the powerline.

The CAN message starts with transmitting an arbitration pattern according to the ID bits in the CAN message received from CAN controller. The receiving DCAN500 detects the bitrate from the received message.

3.2 Constrains

* In case the DCAN500 receives a CAN messages from the DC line while the CAN controller starts transmitting its CAN message, the DCAN500 will issue a 'dummy' CAN message with ID '0' and DLC '0' (empty message) to stop the CAN controller's message transmission and 'hold' the CAN bus until the DC line is idle again. In such case, the CAN controller will lose arbitration and become a receiver. It does not affect transmitter's error counter. The DCAN500 will repeat issuing the dummy CAN message as long as the DC line is not idle.

* In case the CAN Controller starts to transmit a new CAN message whereas its previous CAN message is still being transmitted over the powerline (See DCAN500 Timing in section 3.3), the DCAN500 will issue a 'dummy' CAN message to the CAN controller until completion of the CAN powerline transmission. In such case, the CAN controller will lose arbitration and become a receiver. It does not affect transmitter's error counter. The DCAN500 will repeat issuing the dummy CAN message as long as the DC line is not idle.

3.3 DCAN500 Timing

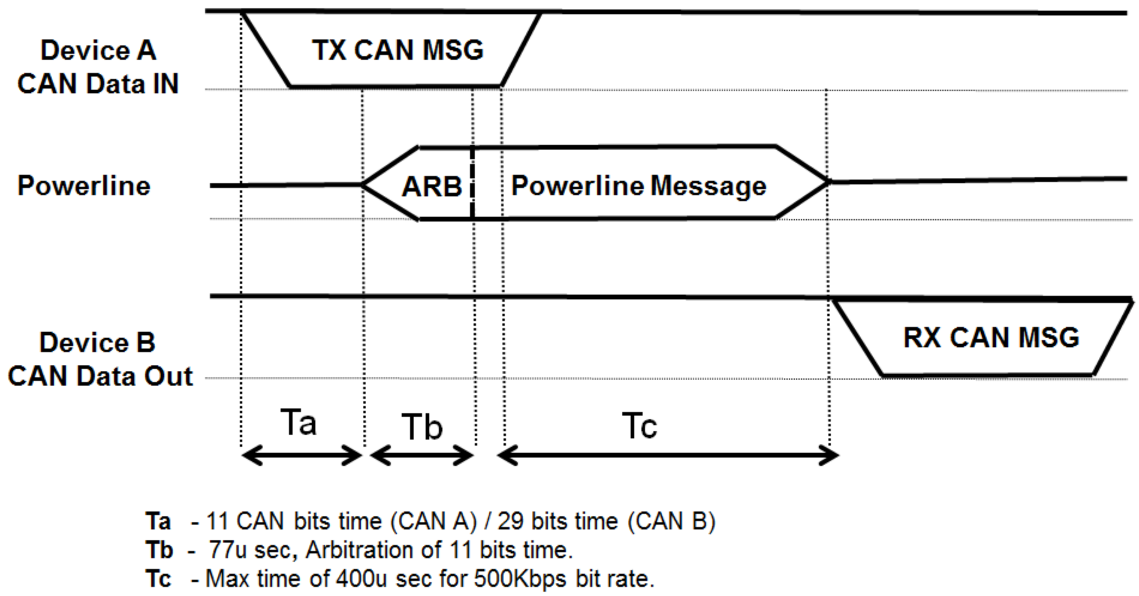

Figure 3 - DCAN500 Typical MSG Timing

3.4 Read / Write To Internal Registers Operation

By lowering the HDC pin (Data Command, J1 pin2) the DCAN500 enters the command mode. Command mode allows the CAN controller to write and read from DCAN500 internal registers. When entering the Command mode, all CAN messages over the DC line are ignored and all CAN controller messages will not be transmitted over the DC line.
When the CAN controller raises the HDC pin, the device exits the command mode.

Write Command

Write command consist of regular CAN message consisting 2 bytes. (Identifier is overlooked).
The first byte should be 'Y5', whereas ' Y' is the address of the target internal register.
The Second byte should be the new value of the register.
For example, to write the value 'EF' to register address 3, the CAN controller should produce a CAN message with 2 bytes of '35', 'EF'.

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Read Command

Read command consist of regular CAN message of 2 bytes. (Identifier is overlooked).
The first byte should be 'Yd', whereas ' Y' is the address of the internal register to read from.
The Second byte should be 'FF'.
Upon receiving a read command from the CAN controller, the DCAN500 will reply with a CAN message with Identifier '0' consist of 1 byte of value of the read register.
For example, for reading the value of register address 2, the CAN controller should produce a CAN message with 2 bytes of '2d', 'FF'.
The DCAN500 will reply with CAN message with ID '0' consist of 1 byte with the value of register 2.

4. Sleep mode

The device has three power consumption modes: Normal Mode (normal transmitting and receiving), Sleep Mode (power saving mode), and Standby Mode (after waking up, while pin nSleep is low). A transition between these modes depends on the sleep control pin, or remotely, when a Wakeup message detected on the bus.

During the Sleep mode, the device enters into power saving operation where only its internal low frequency clock operates. The device wakeup every 32mS for duration of 1.5mS to detect a dedicated wakeup message on the DC-BUS. If such message detected, the device switches to Standby mode, raising its INH pin to indicate its controller that a wakeup message detected. It is the responsibility of the controller to raise the nSleep pin in order to switch to Normal operation mode.

Entering Sleep mode

The controller can place the device into Sleep mode by a lowering to "0" (falling edge) pin nSleep .When the device enters to Sleep mode it lowers pin INH.

There are two ways to wakeup the device from Sleep mode.

Wakeup from pin nSleep

In this case, the controller wakes the DCAN500 by raising the nSleep pin. The raise the INH pin and start automatically to transmit the wakeup message.

The device transmits the wakeup message to wakeup all other devices on the DC-BUS. While transmitting this wakeup message to the DC-BUS, the device lowers pin HDO. After the transmission is complete the device raises pin HDO (can be used to signal/interrupt the controller). After the transmission is completed and pin nSleep is high, the device enters Normal mode. See Figure 5 for signals description.

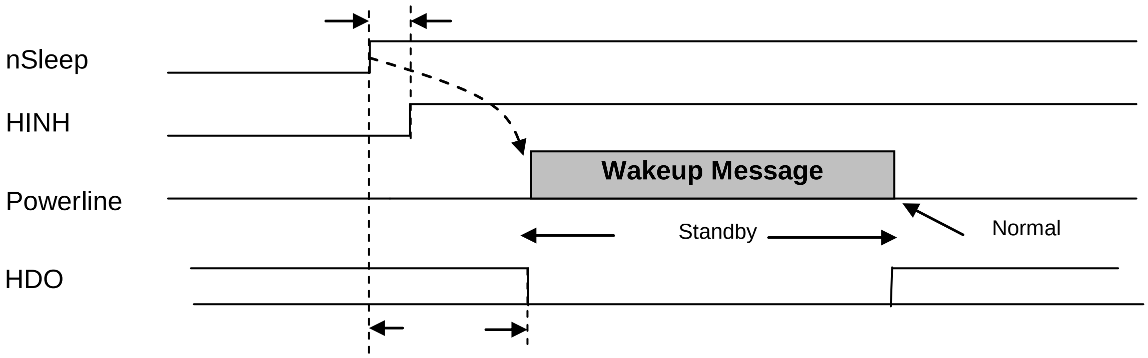

Figure 4 - Wakeup from nSleep pin

Wakeup from bus message

During Sleep mode, the device wakes up every 32mS periodically to check for activity on the bus. If a wakeup message detected, the device enters Standby mode and raises pin INH. The device then signals the controller by lowering pin HDO for a minimal duration of 8 bits, and a maximal duration of about 150mSec. The controller has to raise nSleep pin (otherwise, the device will remain in Standby mode). After completing the reception, the device enters Normal mode. See Figure 5.1 for signals description.

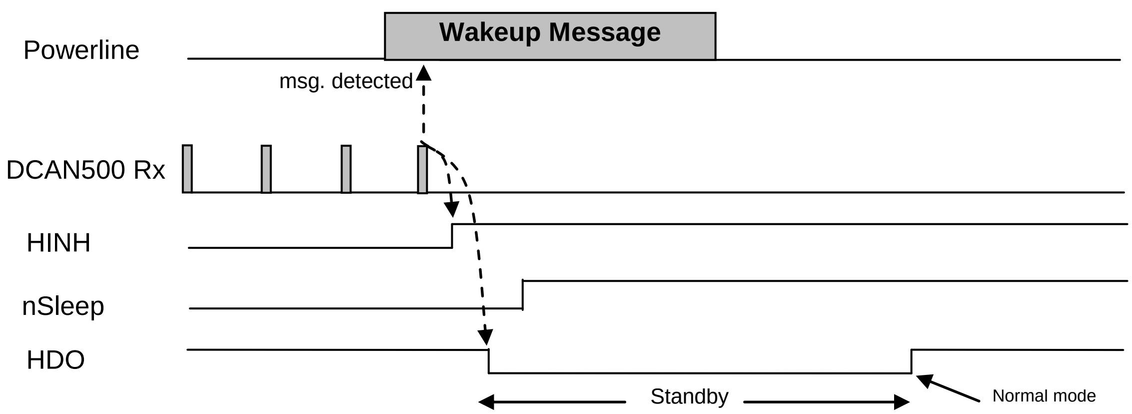

Figure 4.1 - Wakeup from bus message