

## IMPLEMENTATION OF CONTROLLER AREA NETWORK NODE FOR HUMIDITY MEASURING SYSTEMS

BY

**GEORGE-ANDREI URSAN\***, **EMIL VREMERĂ** and **MARIA URSAN**

“Gheorghe Asachi” Technical University of Iași,  
Faculty of Electrical Engineering, Energetics  
and Applied Informatics

Received, June 12, 2011

Accepted for publication: August 16, 2011

**Abstract.** The implementation of CAN node for humidity measuring systems is studied. Humidity sensor used is the HIH-4000 series from Honeywell, connected directly to a controller or other device because the output voltage is linear. Possible application for vehicles that can be made with HIH-4000 humidity sensor is the HVAC (Heating, Ventilation and Air Conditioning) system. Experimental results based on measuring system are analysed.

**Key words:** CAN; humidity sensor; LabView application.

### 1. Introduction

Controller Area Network (CAN) is a serial communication protocol used for communication between microcontrollers. In automotive it is used to exchange information between onboard Electronic Control Units such as the Engine Management System, transmission, instrument packs, and body electronics. CAN makes the connection between nodes using two wires, twisted pair cable. The advantage of using CAN in automotive industry is the great diminution of the electrical connections weigh because CAN replaces a lot of

---

\* Corresponding author: *e-mail: [agursan@ee.tuiasi.ro](mailto:agursan@ee.tuiasi.ro)*

wires used for connections (CAN Specification, 1991; Ursan *et al.*, 2009; Alves *et al.*, 2009).

## 2. The Acquisition Node Based on CAN

The acquisition node, based on CAN protocol, used to monitor humidity, is presented in Fig. 1. It consists on a PIC18F458 microcontroller and an MPC2551 transceiver chip. CAN node is connected with two wires, finished with a 120  $\Omega$  resistor for each end.

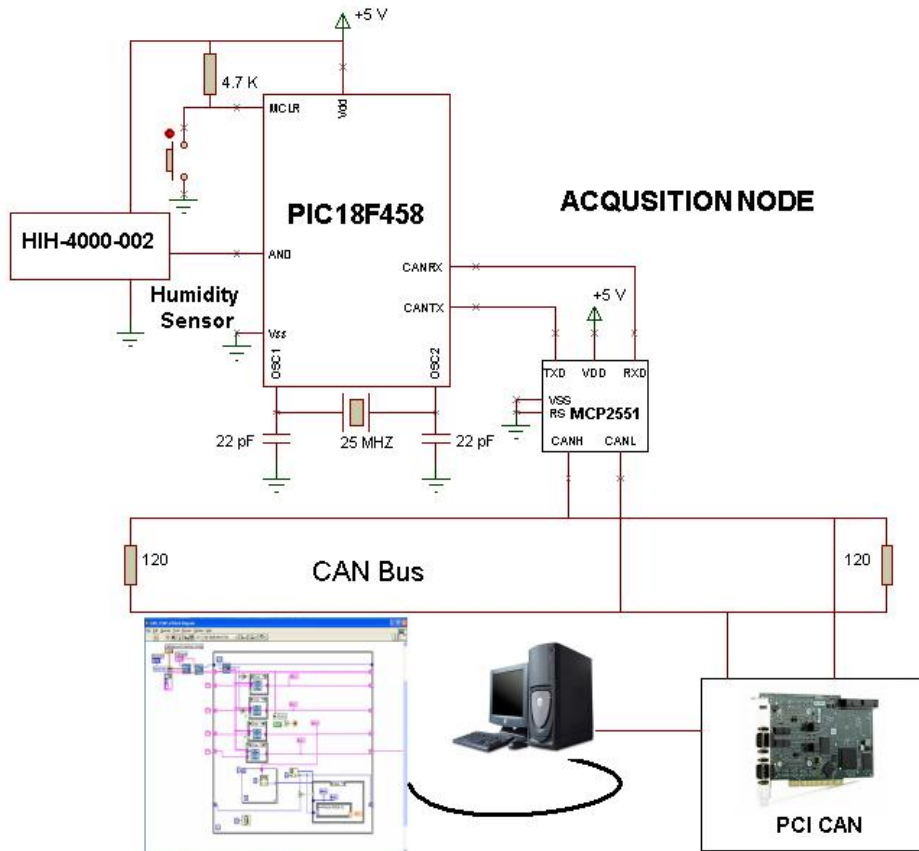


Fig. 1 – Acquisition node for humidity monitoring.

The microcontroller is operated from a 25 MHz crystal. The MCLR input is connected to an external reset button. Analog input AN0 of the microcontroller is connected to a HIH-4000-002 humidity sensor.

Further, in Fig. 2 is represented the block diagram corresponding to the LabView application, used for the acquisition and graphical representation of humidity values, obtained from HIH-4000-002 sensor. LabView software also

allows all acquired data to be saved in text file for further processing (Ursan *et al.*, 2010; Flaming, 2008; Daly, 2006).

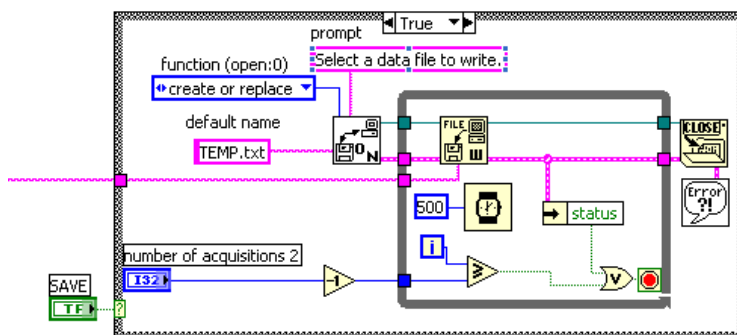
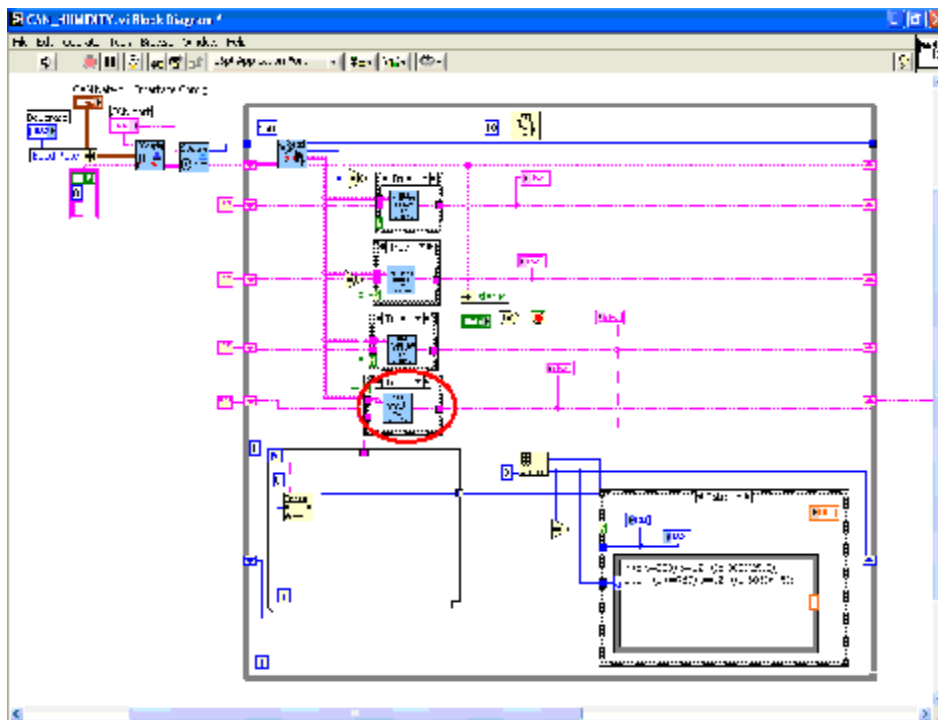


Fig. 2 – Block diagram corresponding to LabView application used for the acquisition and graphical representation of humidity values.

The block diagram of the item “Net Cluster Array To String” from Fig. 2 has been amended so that after data acquisition in hexadecimal format, a conversion was made for these data in proportional values of humidity (40 values), as it is shown in Fig. 3.

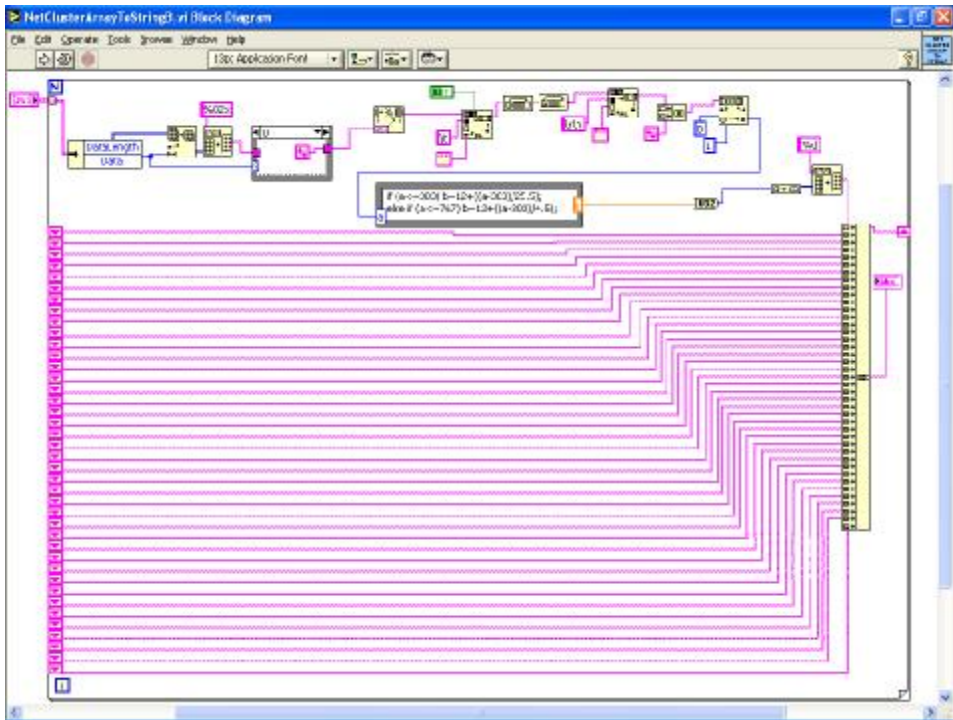


Fig. 3 – Block diagram used to convert acquired data in proportionate humidity values.

### 3. Results and Discussion

The system for monitoring the humidity was tested by using a BINDER climatic chamber (Fig. 4). Temperature inside the BINDER climate chamber was set at 15°C. After this was introduced inside the BINDER chamber the humidity sensor HIH-4000-002. Temperature was changed after the next interval 15°C...40°C...15°C...40°C and the humidity evolution can be seen in Fig. 5.



Fig. 4 – BINDER climatic chamber.

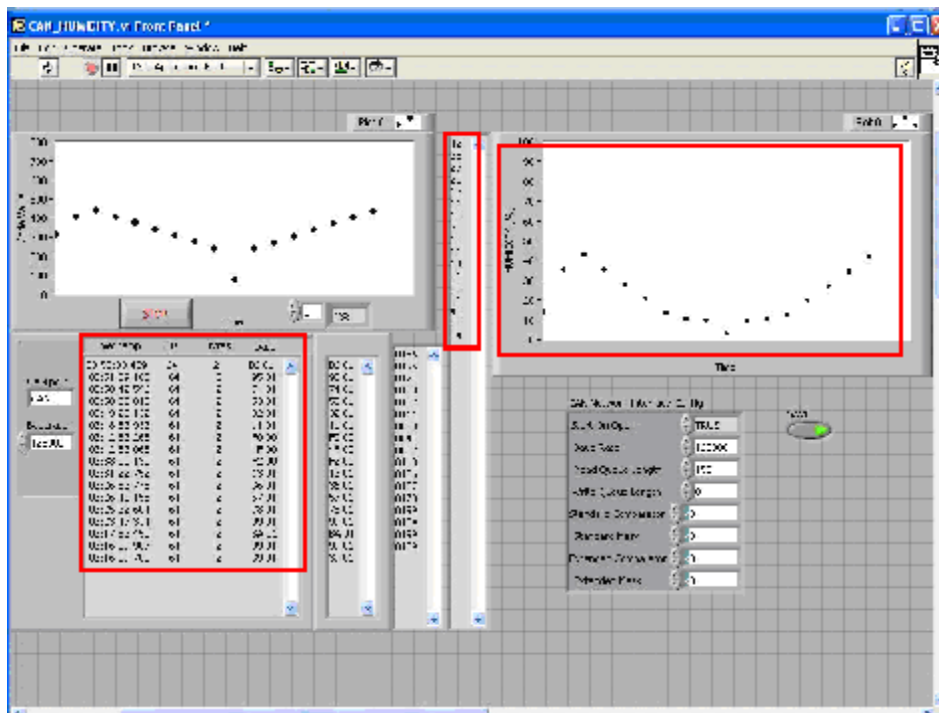


Fig. 5 – LabView front panel for humidity results.

CAN signal shape for two values of humidity obtained with sensor HIH-4000-002 can be seen in Fig. 6.

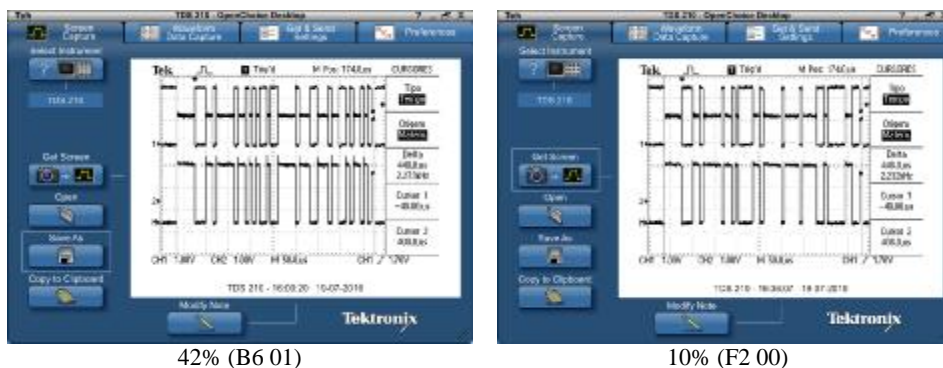


Fig. 6 – CAN signal form corresponding values 42%, respectively 10% humidity.

CAN signal was viewed using a Tektronix TDS oscilloscope, type 210, connected to the computer with NI GPIB-USB-HS.

CAN signal corresponding to 42% humidity value (B601 code) is presented in Fig. 8. Also the Fig. 7 provides the signal shape CANL; CANH; CANL and CANH; CANL, CANH and CANH-CANL.

Capture images were performed with OpenChoice Desktop application (Ursan *et al.*, 2010).

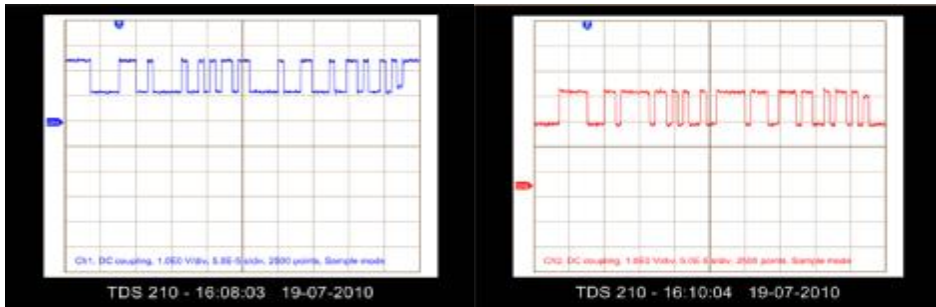


Fig. 7 – Signal CANL and CANH.

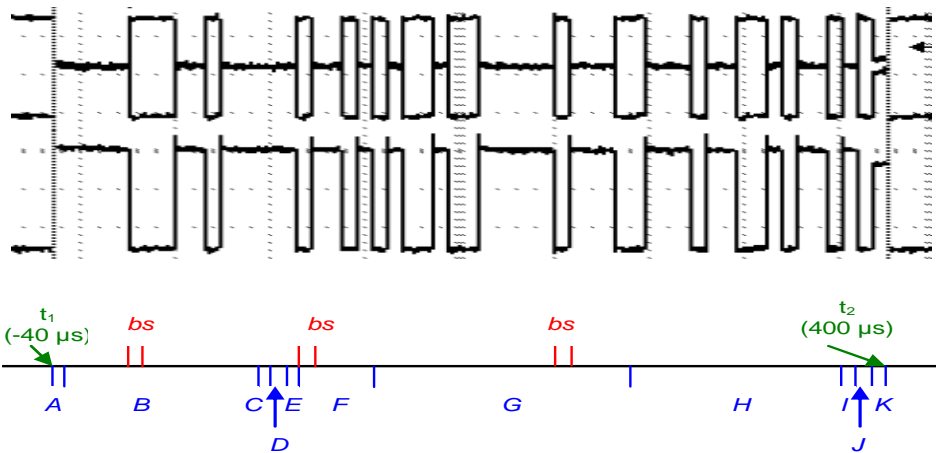


Fig. 8 – Interpretation of CAN signal.

The symbols significance used in Fig. 8 is

A – 1 dominant bit corresponding to the of Start of Frame section;  
 B – 11 bits that, accordingly with CAN Specification 2.0 A, uniquely identifies each communication object, in our case is hexadecimal representation for ID 64 (000 0110 0100);

C – 1 dominant bit which distinguishes data and remote frame types;

D – 1 dominant which corresponds to the identification bit of the plot;

E – 1 dominant bit reserved r0;

$F$  – 4 bits corresponding to Data Length Code, in this case DLC is 2 (0010);

$G$  – 16 bits are used for transferring information B601, which in hexadecimal is 1011 0110 0000 0001;

$H$  – 15 bit corresponding to Cyclic Redundancy Code used by receivers to check the integrity of incoming frames;

$I$  – 1 recessive bit corresponding to Cyclic Redundancy Code Delimiter;

$J$  – 1 dominant bit corresponding to Acknowledge Field;

$K$  – 1 recessive bit which corresponds to Confirmation Field;

$bs$  – Bit Stuffing.

With Baud Rate at 125 kbit/s we can obtain the time bit, which is  $t_{\text{bit}} = 8 \mu\text{s}$ . The total time of the frame is  $440 \mu\text{s}$  which corresponds to 55 bits. From this 55 bits, 52 bits are dedicated for transfer of data B601, with ID 64 and data length DLC = 2. The others bits are 3 bit stuffing connections (CAN Specification, 1991; Ursan *et al.*, 2010).

#### 4. Conclusions

The system for monitoring the humidity in vehicles was developed using the main properties of CAN protocol. The signal obtained from humidity sensor was analysed and it was made an interpretation for this, exemplifying each field from the diagram.

**Acknowledgments.** This work was developed in the framework of the Project “BRAIN” (PhD Scholarships ID 6681, OI POS DRU Ministry of Education, Research and Innovation).

#### REFERENCES

- Alves M., Pereira M., Geirinhas Ramos H., *CAN Protocol: A Laboratory Prototype for Fieldbus Applications*. XIX IMEKO World Congress Fund. a. Appl. Metrol., Lisbon, Portugal, 2009, 454-457.
- Daly S., *Automotive Air-Conditioning and Climate Control Systems*. Elsevier, 2006.
- Fleming W.J., *New Automotive Sensors – A review*. IEEE Sens. J., **8**, 1900-1921 (2008).
- Ursan G.-A., Vremeră E., Ursan M., Plopa O., *Advanced Automotive Communication Networks, CAN Protocol Technology*. Bul. Inst. Politehnic, Iași, **LV (LIX)**, 3, s. Electrot., Energ., Electron., 43-56 (2009).
- Ursan G.-A., Postolache O., Ursan M., Vremeră E., Pereira M., *Using the CAN Protocol for Climate Control System in Automotive Indoor Monitoring*. 17th Symp. IMEKO TC 4, 3rd Symp. IMEKO TC 19 and 15th IWADC Workshop, Kosice, Slovakia, 1-5, 2010.
- \* \* *CAN Specification Version 2.0*, Bosch GmbH, on-line at: <http://www.semiconductors.bosch.de/pdf/can2spec.pdf>, Stuttgart, 1991.
- \* \* [http://sensing.honeywell.com/index.cfm?ci\\_id=140301&la\\_id=1&pr\\_id=145601](http://sensing.honeywell.com/index.cfm?ci_id=140301&la_id=1&pr_id=145601).

## IMPLEMENTAREA UNUI NOD CAN ÎNTR-UN SISTEM DE MONITORIZARE A UMIDITĂȚII

(Rezumat)

Se prezintă un sistem de monitorizare a umidității în vehicule bazat pe principiul protocolului CAN. Rezultatele obținute de la senzorul de umiditate au fost prelucrate cu ajutorul unei aplicații LabView. Aceasta permite ca datele obținute să fie salvate și într-un fișier text pentru o prelucrare ulterioară a lor. Pentru valoarea de 42% a fost analizat semnalul CAN corespunzător, cu repartitia biților pentru fiecare câmp de date.