CANopen

Indicator Specification

Draft Recommendation 303-3

Version 1.0 – June 2001

History

Date	Status
1 June 2001	Initial

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1 Scope

A common behaviour of indicators helps service personnel to identify communication problems quickly without checking manuals for each device. This recommendation intends to specify the implementation of status LEDs (Light Emitting Diode) on CANopen devices.

This recommendation only describes the communication-related indicators. Additional application-related indicators may be present. Their use is either described in the appropriate device profile or is manufacturer-specific.

2 References

/1/: CiA DS-301: CANopen – Application Layer and Communication Profile, Version 4.01. CiA, Erlangen, June 2000
/2/: CiA DSP-302: Framework for Programmable CANopen Devices, Version 3.0. CiA, Erlangen, June 2000
/3/: CiA DR-305, LSS – Layer Setting Services and Protocol, Version 1.0. CiA, Erlangen, May 2000

3 Indicators

It is either recommended supporting two CANopen LEDs: one red ERR LED and one green RUN LED or a combination of both using one bicolor (green/red) LED called STATUS LED.

Additional LEDs for power indication, I/O functionality etc. are allowed.

3.1 Indicator states and flash rates

The following Indicator states are distinguished:

LED on	constantly on
LED off	constantly off
LED flickering	iso-phase on and off with a frequency of approximately 10 Hz: on for approximately 50 ms and off for approximately 50 ms.
LED blinking	iso-phase on and off with a frequency of approximately 2,5 Hz: on for approximately 200 ms followed by off for approximately 200 ms.
LED single flash	one short flash (approximately 200ms) followed by a long off phase (approximately 1000 ms).
LED double flash	a sequence of two short flashes (approximately 200ms), separated by an off phase (approximately 200ms). The sequence is finished by a long off phase (approximately 1000 ms).
LED triple flash	a sequence of three short flashes (approximately 200ms), separated by an off phase (approximately 200ms). The sequence is finished by a long off phase (approximately 1000 ms).

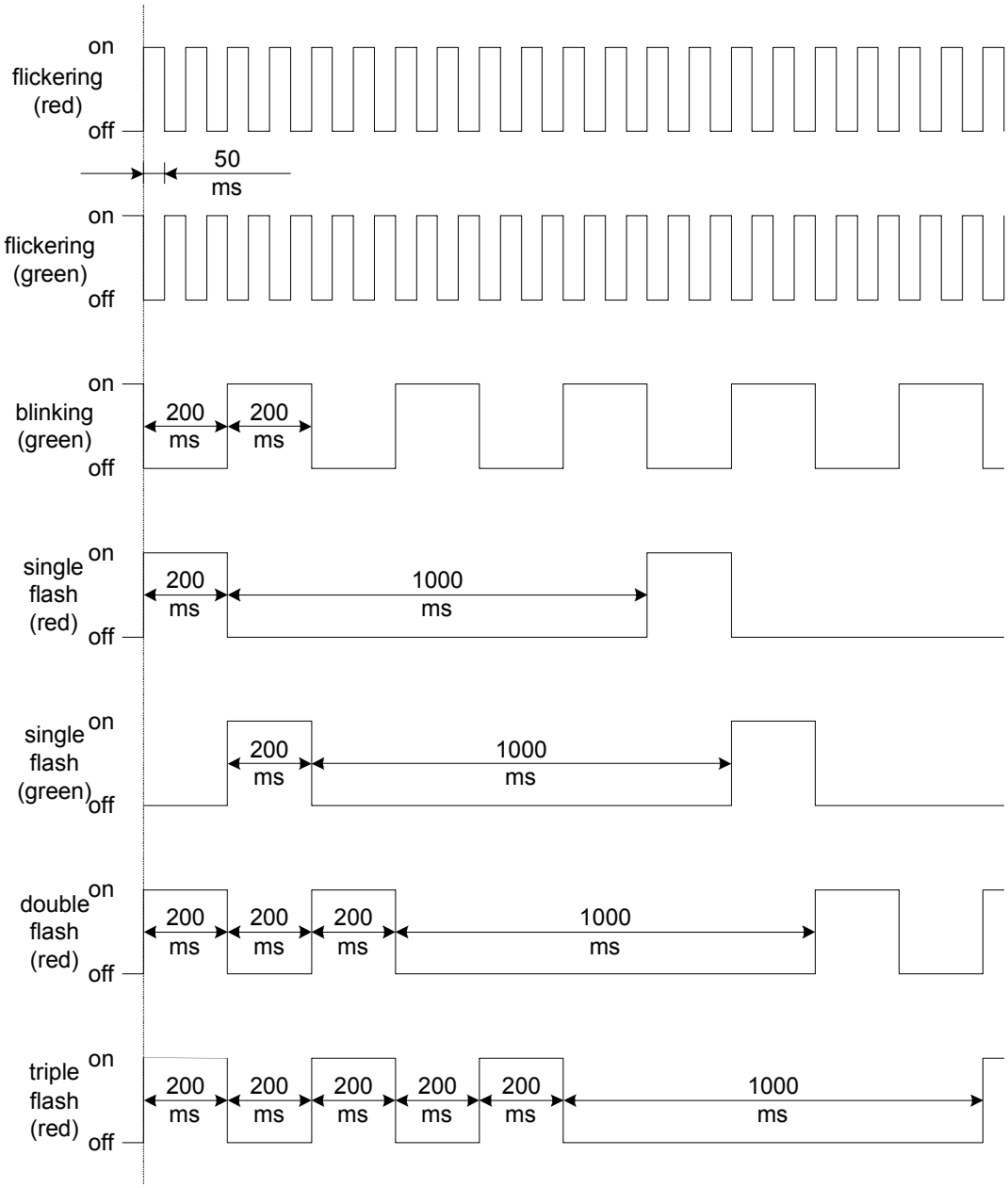

Figure 1: Indicator states and flash rates

3.2 CANopen ERROR LED

The CANopen Error LED indicates the status of the CAN physical layer and indicates errors due to missing CAN messages (SYNC, GUARD or HEARTBEAT). It shall be red.

No	ERROR LED	State	Description	Category
1	Off	no error	The Device is in working condition.	Mandatory
2	Single flash	warning limit reached	At least one of the error counters of the CAN controller has reached or exceeded the warning level (too many error frames).	Mandatory[1]
3	Flickering	AutoBaud/LSS	Auto Baudrate detection in progress or LSS services in progress (Alternately flickering with RUN LED)[2]	Optional
4	double flash	Error Control Event	A guard event (NMT-Slave or NMT-master) or a heartbeat event (Heartbeat consumer) has occurred.	Mandatory
5	triple flash	Sync Error	The SYNC message has not been received within the configured communication cycle period time out (see Object Dictionary Entry 0x1006).[3]	Conditional; Mandatory if Object 0x1006 is supported
6	On	Bus Off	The CAN controller is bus off	Mandatory

Table 1: CANopen ERROR LED truth table

If at a given time several error are present, the error with the highest number is indicated (e.g. if NMT Error and Sync Error occur, the SYNC error is indicated).

[1] Should be “OPTIONAL”, if there are CAN controllers available which do not indicate the warning level. Please report if you are aware of such CAN controller implementations.

[2] An LSS Master should flicker its ERROR and RUN LED as well whilst executing LLS services.

[3] Object 0x1006 contains the sync cycle period in ms. The sync cycle period time out shall be the configured sync cycle period multiplied by 1,5 (this is not specified in DS-301, but shall be regarded as application note).

3.3 CANopen RUN LED

The CANopen RUN LED indicates the status of the CANopen network state machine. It shall be green.

No	CAN RUN LED	State	Description	Category
1	Flickering	AutoBaud/LSS	Auto Baudrate detection in progress or LSS services in progress (Alternately flickering with ERROR LED)	Optional
2	single flash[4]	STOPPED	The Device is in STOPPED state	Mandatory
3	Blinking	PRE-OPERATIONAL	The Device is in the PRE-OPERATIONAL state	Mandatory
4	On	OPERATIONAL	The Device is in the OPERATIONAL state	Mandatory

Table 2: CANopen RUN LED truth table

Whilst the device is executing a reset the CANopen RUN LED shall be off.

3.4 CANopen STATUS LED

If one bicolor Status LED is used instead of two single color LEDs, this LED shall indicate both the physical bus status and the status of the CANopen state machine. This bicolor LED shall be red and green.

In case there is a conflict between turning the LED on green versus red, the LED may be turned on red. Apart from this situation, the bicolor status LED shall combine the behavior of the CAN Error LED and of the CAN RUN LED.

Examples for behavior of bicolor CANopen Status LED:

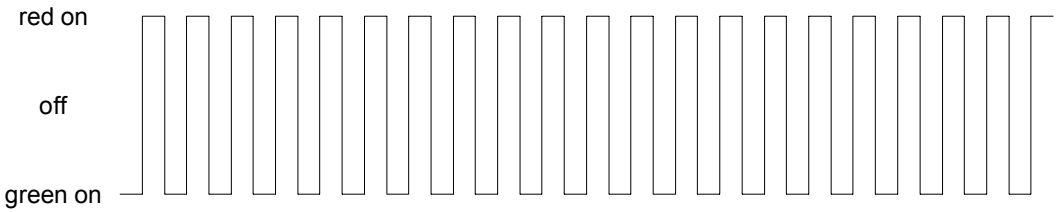

Figure 2: Flickering Green/Red: Autobaud/LSS

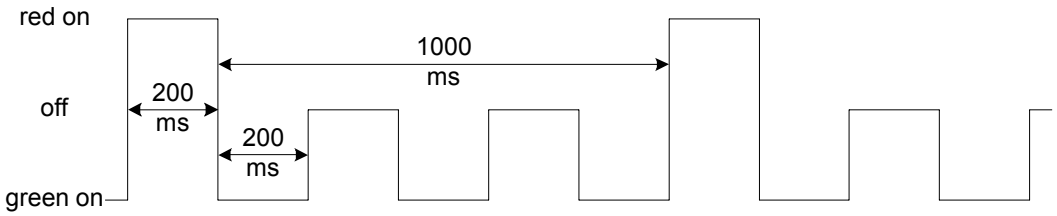

Figure 3: Single Flash red combined with blinking green:
"CAN Warning Limit reached" during Pre-Operational State.

[4] The single flash was introduced (instead of "off") in order to avoid situations where all LEDs are off for a long period of time (especially on small devices that do not carry additional LEDs e.g. for power indication).

4 Recommended labeling

It is recommended to label the CANopen LEDs as follows:

Description	Full Name	Abbreviated Name
CANopen Error LED	ERROR LED	CAN-ERR or ERR
CANopen Run LED	RUN LED	CAN-RUN or RUN
CANopen Status LED	STATUS LED	CAN-STATUS or CAN

Table 3: Recommended labeling

CANopen

Sales and Distribution:

CAN in Automation GmbH

Am Weichselgarten 26
D-91058 Erlangen

Tel +49-9131-69086-0
Fax +49-9131-69086-79

headquarters@can-cia.org
www.can-cia.org