ZES ZIMMER

Precision Power Measurement

LMG600 – CAN Bus
Hardware Option L6-OPT-CAN

M.Sc. Patrick Fuchs
ZES ZIMMER Electronic Systems GmbH

Tel: +49 6171 6287-71
Fax: +49 6171 52086
E-Mail: pfuchs@zes.com

Outline

1 CAN Feature

2 CAN Transmission

3 CAN Trigger

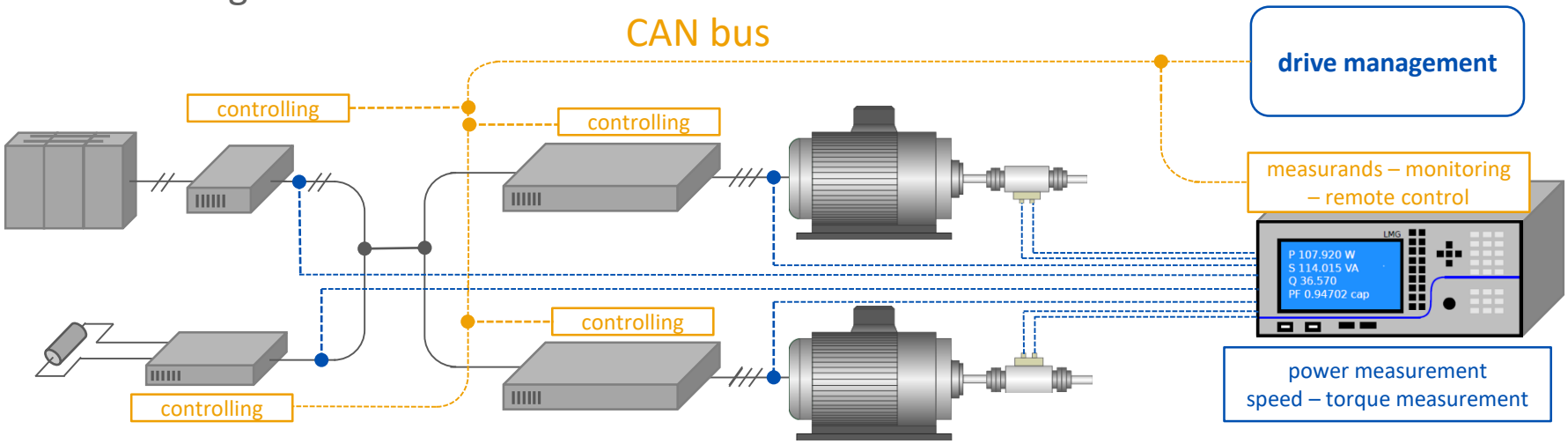
4 Appendix

1 CAN Feature
2 CAN Transmission
3 CAN Trigger
4 Appendix

CAN Feature

The importance of the CAN bus interface

The use of the CAN bus as a communication bus in the electrical drive technology sector is steadily increasing. The reduced effort with regard to the cable trees is an advantage in a compact drive system. Power measuring devices experience the requirement to communicate measured values via the CAN bus to the control unit. This is applicable amongst others in the course of the electrification of vehicle drive trains or generally in the control and regulation of electrical machines



ZES ZIMMER
Precision Power Measurement

CAN Feature

What can bus interface be used for?

Using a single communication level for the whole system ensures less programming effort and quick implementation of the power analyzer.

Industries

- Automotive
- Aerospace
- Automation
- Railway
- Elevators

Applications

- In-car powertrain & drivetrain testing
- Dynamometer for engine testing
- PA remote control
- Reading/ monitoring of measurands
- Control automation processes
- Reading values from CAN bus

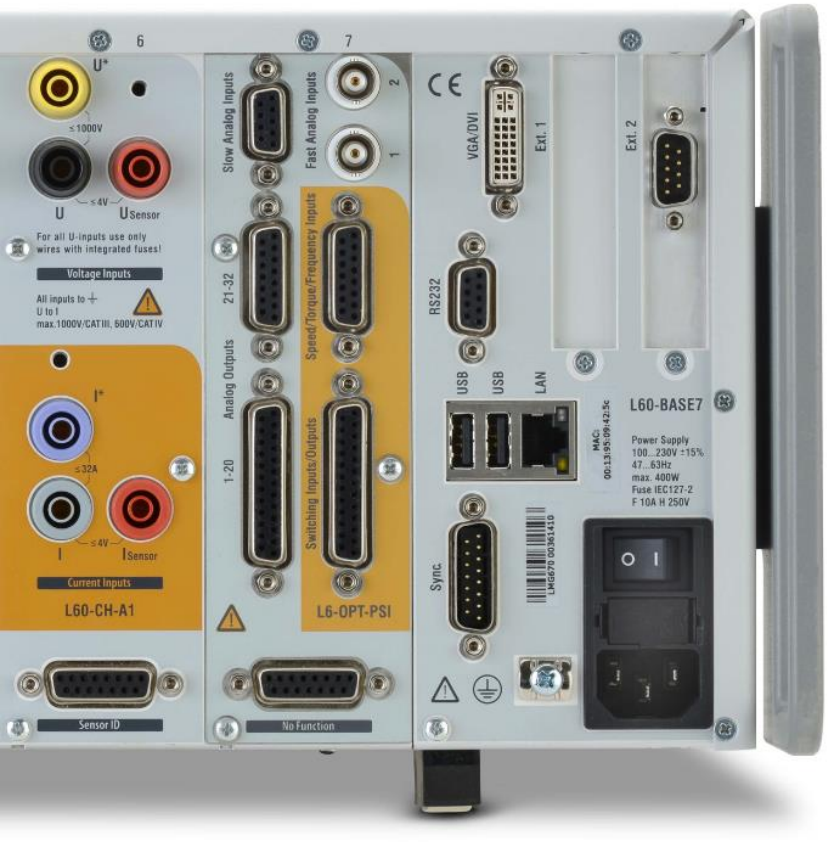
CAN Feature

Key features of software option L6-OPT-CAN:

- Easy integration in CAN-Bus systems without additional substitution technologies
- Application in closely networked environments as test labs and test benches
- Bi-directional data transmission: sending on and reading from bus
- CAN-Bus connectivity according to ISO 11898-2 (high-speed CAN)
- 128 slots for broadcasting measurands on different CAN IDs
- Trigger configuration on 128 slots for receiving data over the CAN bus
- Export of transmit settings (Transmit tab) in DBC format
- Providing the Extended Frame Format for higher upper limits of the CAN ID

CAN Feature

CAN it be true? – Yes it CAN!



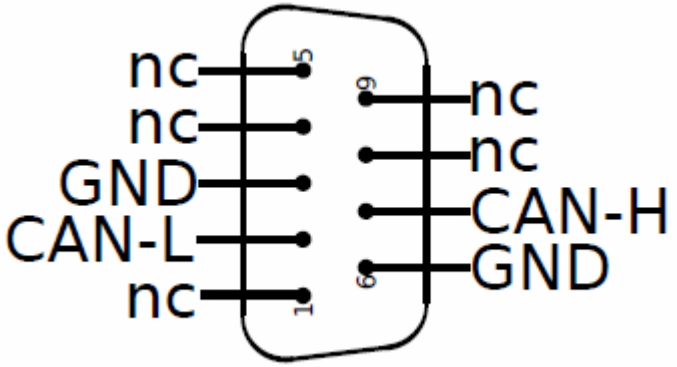
- Equip the LMG600 power analyzer with a CAN bus interface
- Retrofitting the CAN bus interface does not effect the accuracy of the power channels
- Available for all LMG600 series power analyzers: LMG610/640/670

ZES ZIMMER
Precision Power Measurement

CAN Feature

Rearside CAN bus interface

- Accessible via 9-pin D-SUB connector (as to CiA® 102)*
- Galvanic isolation up to 500V
- Conforming to ISO 11989-2 (Highspeed CAN)
- Supports CAN Standards 2.0A and 2.0B
  - Send and receive CAN messages with 11 or 29 bit CAN-IDs
- Bus speed between 5 kbit/s and 1 Mbit/s



*There is no internal termination, therefore, the device must be used on a terminated bus, see appendix.

ZES ZIMMER
Precision Power Measurement

1 CAN Feature

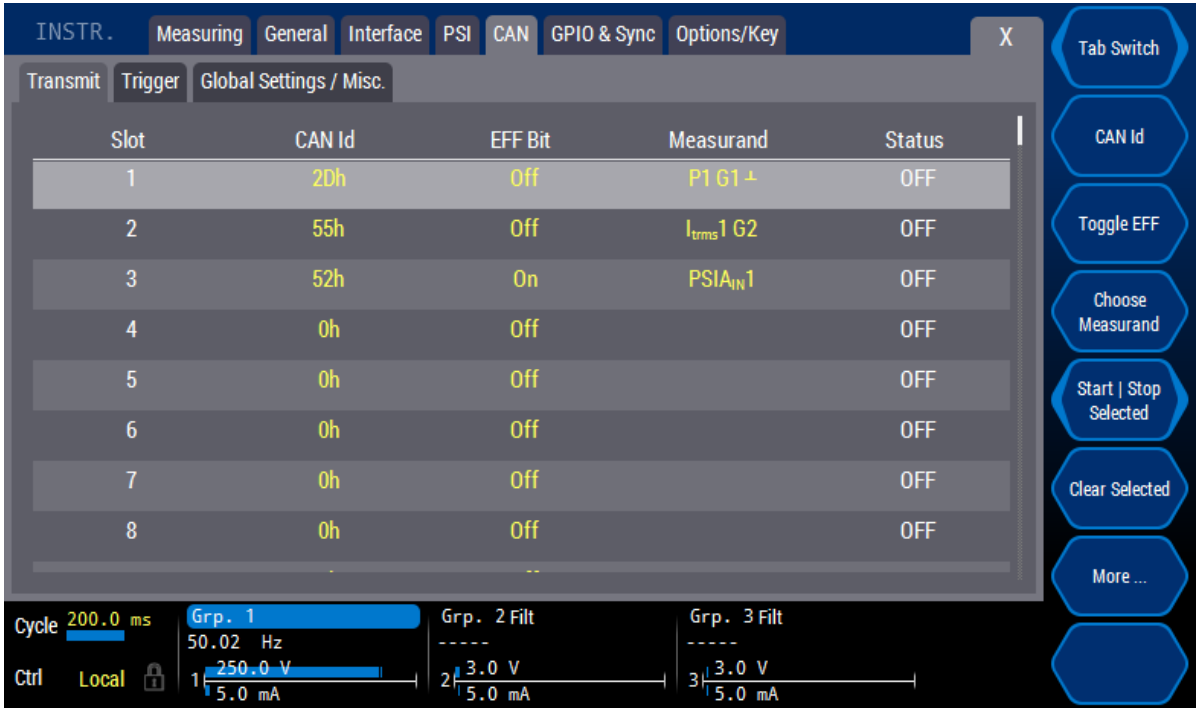
2 CAN Transmission

3 CAN Trigger

4 Appendix

CAN Transmission

<INSTR.> Menu → *CAN* → **Transmit**

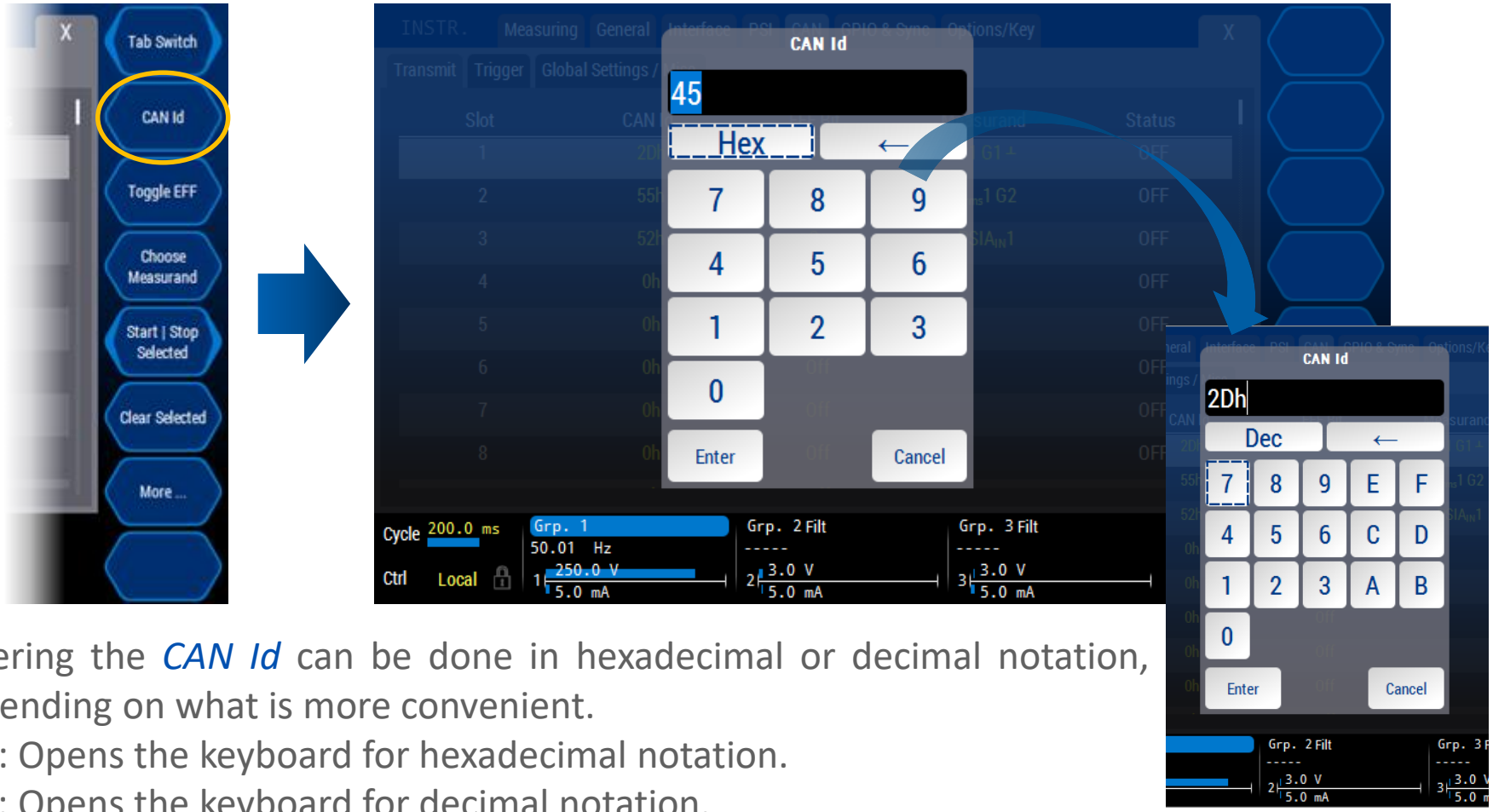


In the *Transmit* tab each of the 128 available slots can be specified with an exclusive CAN Id and a specific value to be sent. This can be each selectable cycle based measured value. The *EFF Bit* toggles the upper limit of Ids: On → 2047 respectively Off → 536870911. The *Status* row indicates if messages will be sent on the particular Id.

ZES ZIMMER
Precision Power Measurement

CAN Transmission

<INSTR.> Menu → *CAN* → **Transmit**



Entering the *CAN Id* can be done in hexadecimal or decimal notation, depending on what is more convenient.

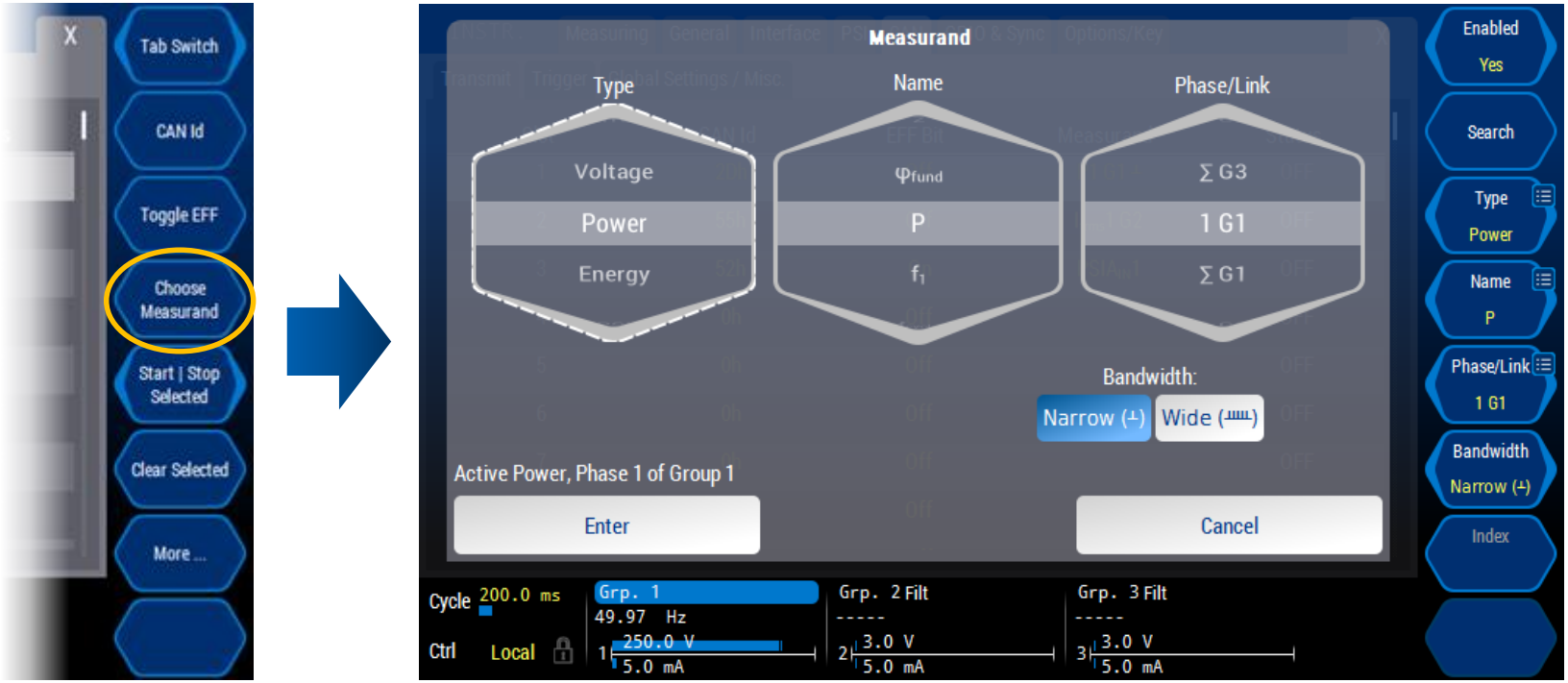
Hex: Opens the keyboard for hexadecimal notation.

Dec: Opens the keyboard for decimal notation.

ZES ZIMMER
Precision Power Measurement

CAN Transmission

<INSTR.> Menu → *CAN* → **Transmit**



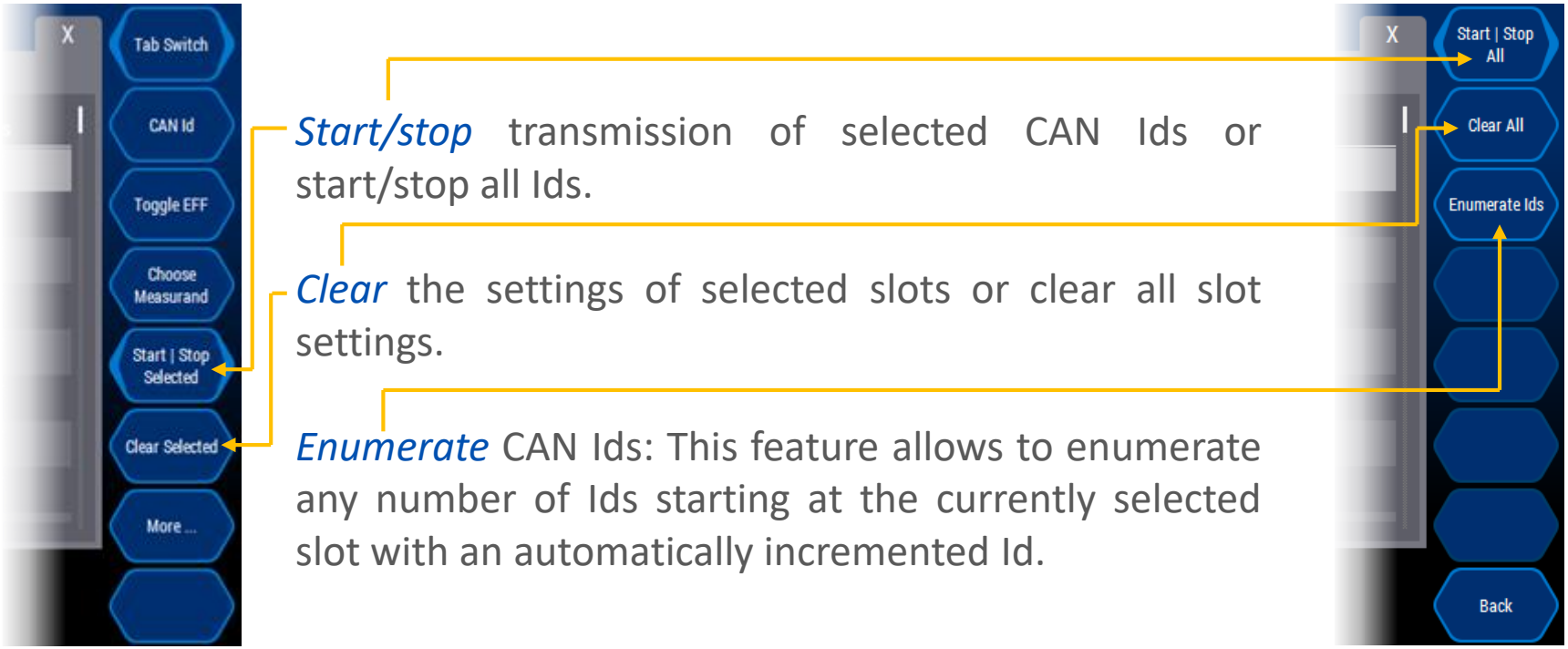
Choose Measurand opens the dialog to assign the desired cycle based calculated measurand to the according CAN Id. This measured value will be transmitted as the reference value in the CAN message.

ZES ZIMMER
Precision Power Measurement

CAN Transmission

<INSTR.> Menu → *CAN* → **Transmit**

The following **controls** are available:



Start/stop transmission of selected CAN Ids or start/stop all Ids.

Clear the settings of selected slots or clear all slot settings.

Enumerate CAN Ids: This feature allows to enumerate any number of Ids starting at the currently selected slot with an automatically incremented Id.

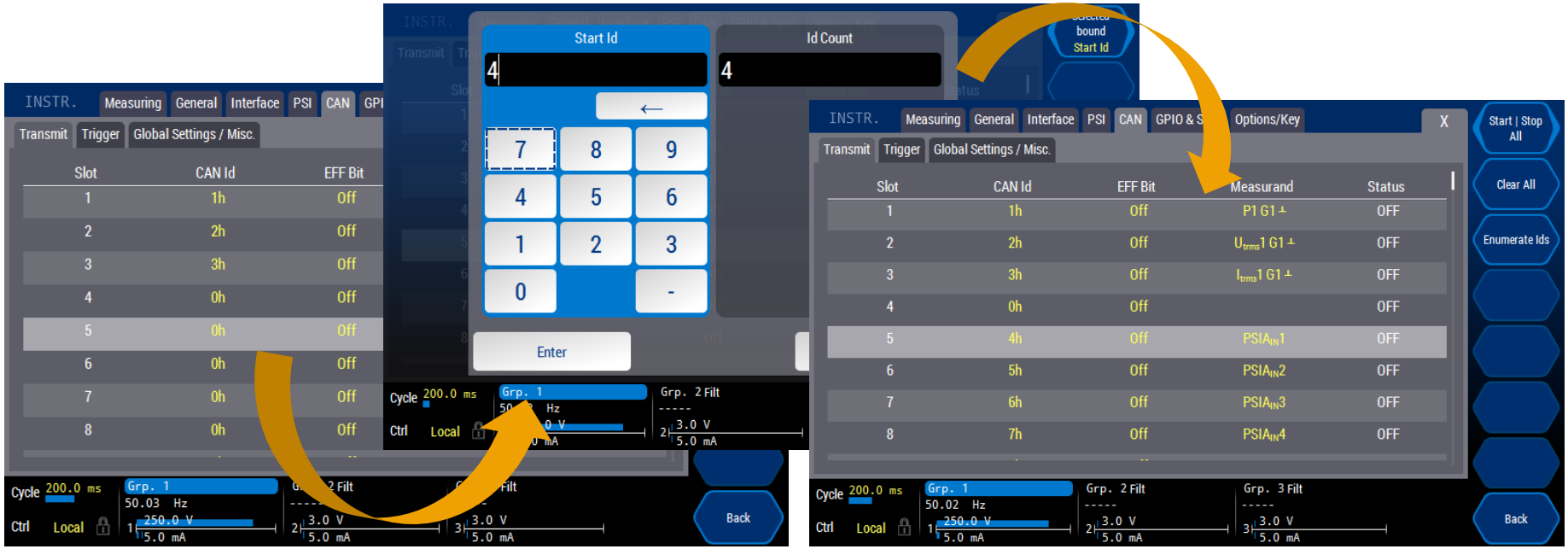
ZES ZIMMER
Precision Power Measurement

CAN Transmission

<INSTR.> Menu → *CAN* → **Transmit**

Assisted **enumeration** of Ids:

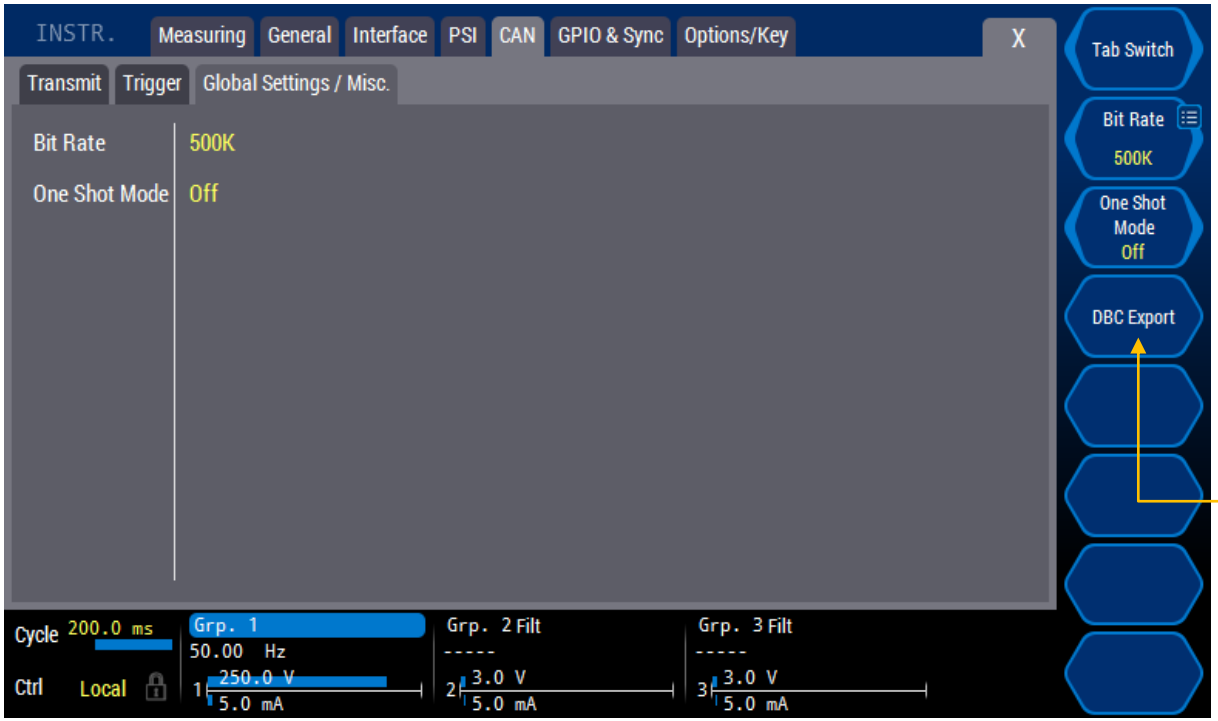
Example: Select slot 5 and use the enumeration soft key to enter the desired "starting" Id = 4_2 and the number of Ids = 4. → Slot 5 to 8 will get the Ids 4 to 7 assigned.



ZES ZIMMER
Precision Power Measurement

CAN Transmission

<INSTR.> Menu → *CAN* → **Global Settings / Misc.**



Set the *Bit Rate* matching the defined speed of the connected bus. A different bitrate can result in other bus-participants considering the LMG's messages as errors on the bus, which leads to a general decline of the bus performance.

Enter this tab to export the currently running CAN configuration in a *DBC* file format.

ZES ZIMMER
Precision Power Measurement

CAN Transmission

<INSTR.> Menu → *CAN* → **Global Settings / Misc.**

One Shot Mode:

Normally, if a CAN message fails to be sent out to the bus, the instrument retries to transmit the message and might give up eventually if the problem prevails. This will turn off the affected CANCONT.

In One-shot mode, an outgoing message will only be tried to transmit once. If a problem occurs, the LMG will silently discard the message. The affected CANCONT will continue trying to transmit any new data.

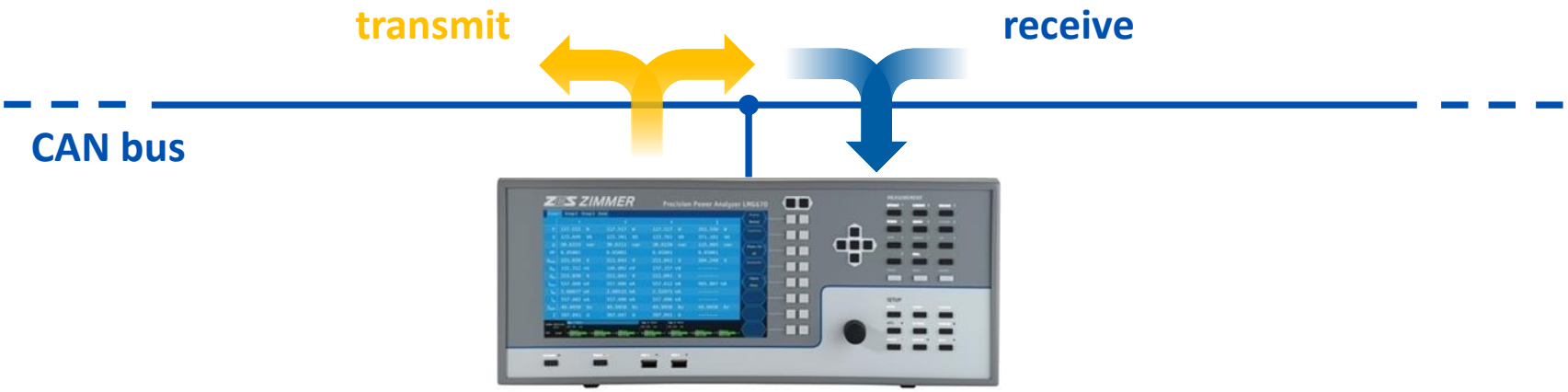
1 CAN Feature
2 CAN Transmission
3 CAN Trigger
4 Appendix

CAN Trigger

Receive CAN messages and execute commands

The LMG600 can also read information sent over the CAN bus and carry out a number of predefined actions based on its content. That is, the CAN bus interface of the power analyzer has become bi-directional, changing it from a purely passive sensor to a remote-controllable analysis tool.[1]

This feature offers a convenient way to e.g. trigger data logging based on environmental conditions or change measuring ranges according to the state of the unit under test.[1]



CAN Trigger

Receive CAN messages and execute commands

Start logging on LMG via CAN message:

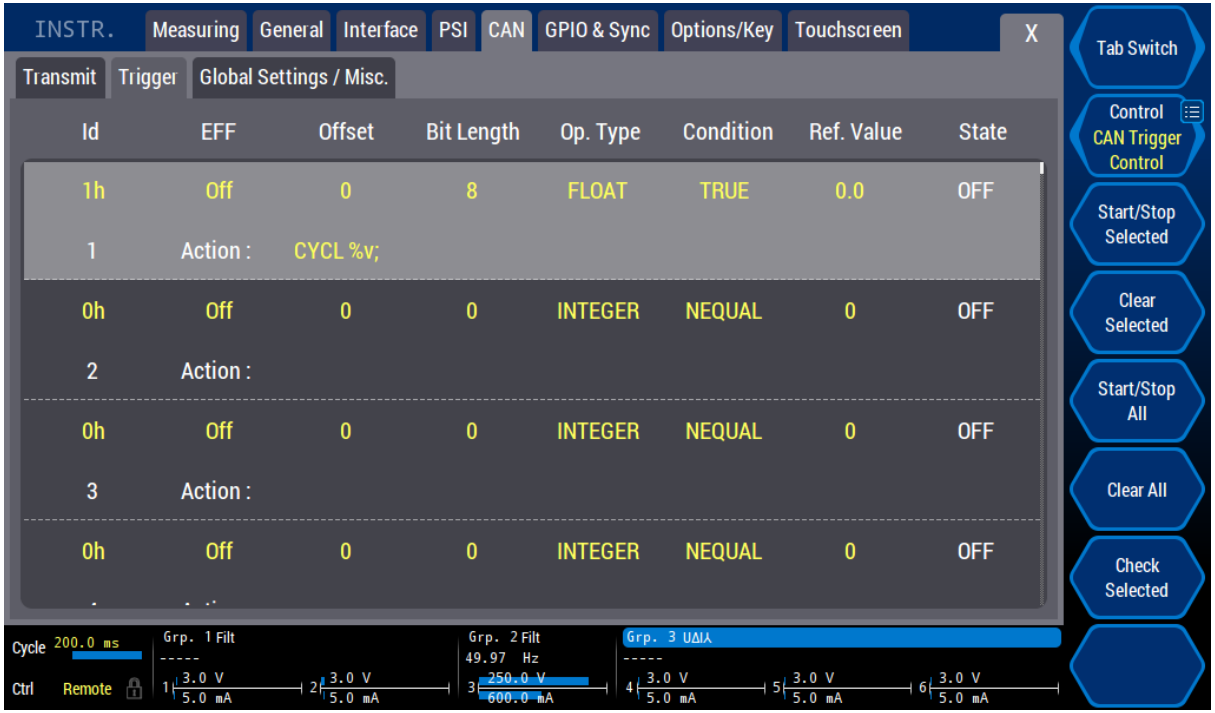
Imagine you would like to initiate logging data once a critical temperature threshold is exceeded at certain location. To implement this procedure you simply would have the LMG600 read the information sent by the respective temperature sensor over CAN and set a trigger condition accordingly. Once the temperature has risen above the limit, recording starts automatically. [1]

Change the measuring range on LMG via CAN message:

Likewise, switching an electrical engine off via CAN could simultaneously trigger a range change in the power analyzer, avoiding the otherwise necessary settling period of the auto-ranging mechanism. The LMG600 allows to define up to 128 trigger conditions to cover automation of even the most sophisticated measurement and recording tasks. [1]

CAN Trigger

<INSTR.> Menu → *CAN* → **Trigger**



The *Trigger* menu provides several settings to configure the slots for receiving data.
On each slot the trigger will execute a command written in the field *Action*. The trigger conditions can be set in the column *Condition* and if required the field *Ref. Value.*

ZES ZIMMER
Precision Power Measurement

CAN Trigger Settings 1/2

CAN Id
Sets the CAN id from which you want to receive data.

EFF
Use the *extended frame format* (On) or not (Off).

Offset
Sets the bit offset of the value to be read.

Bit Length
The number of bits of the value to be read. Note: Floats may consist of either 32 or 64 bits. Integer can have any value of bits from 1 to 64.

Operand Type
Sets whether the data shall be interpreted as integer or float.

CAN Trigger Settings 2/2

Condition
Condition for comparison btw received data and reference value. Note: “True” triggers always.

Reference Value
The value the received data shall be compared with.

Action
The short command, separated by semicolon, to be executed if the condition was met. The received value can be inserted using ´%v´.

State
On: Receive data and trigger/execute an action according the trigger settings.
Off: The CAN trigger is deactivated.

CAN Trigger conditions

EQUAL: Test if the incoming data is equal to the comparison value.

NOT EQUAL: Test if the incoming data is not equal to the comparison value.

LESS OR EQUAL: Test if the incoming data is less than or equal to the comparison value.

LESS: Test if the incoming data is less than the comparison value.

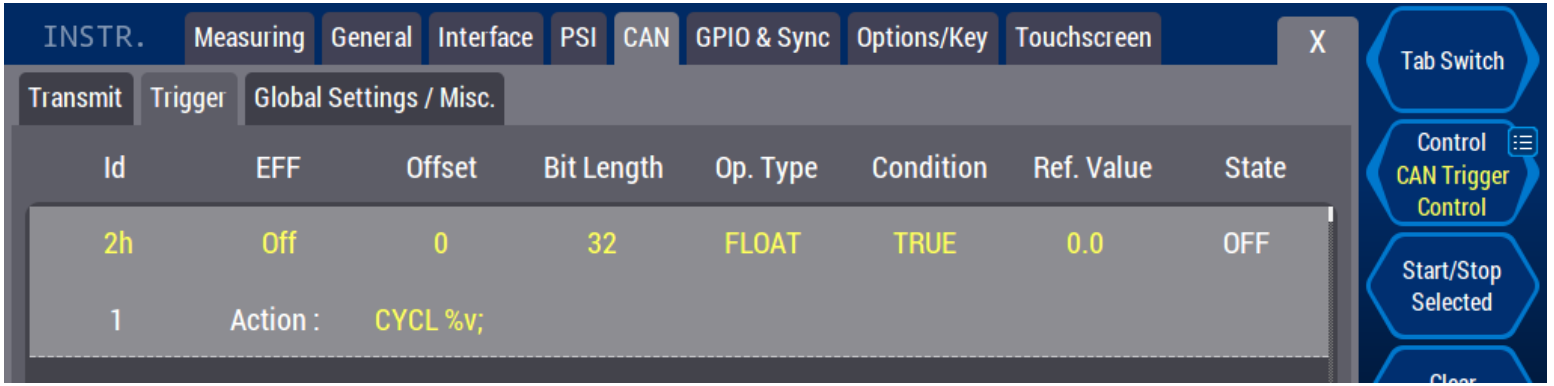
GREATER OR EQUAL: Test if the incoming data is greater than or equal to the comparison value.

GREATER: Test if the incoming data is greater than the comparison value.

TRUE: This evaluates always to true. Useful when receiving a frame is the only information necessary.

CAN Trigger

Example 1: Set the cycle time via a CAN message 1/2

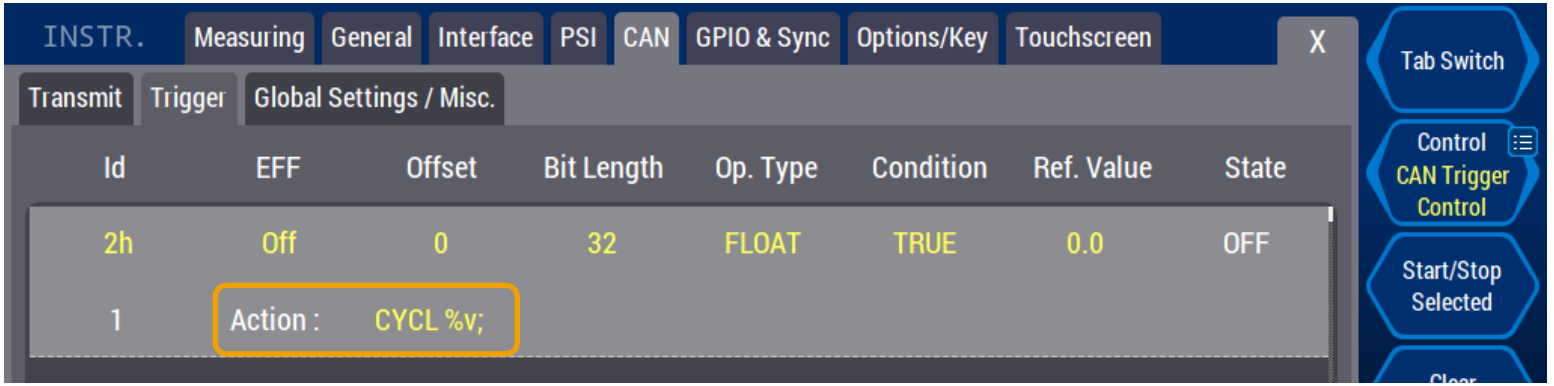


Lets assume the cycle time shall be set to 200ms via a CAN message. The *CAN id* of the message/slot containing is 1. Offset and bit length according the transmitted message (described in *Appendix*).

EFF is set to Off, since the *extended frame format* will not be used in this example. The *operand type* should be set to *FLOAT*, cause the value for the cycle time may be a decimal value. Setting the cycle time shall be done directly after entering/sending the value at/from the transmitting device. Therefore the trigger condition needs to be set to *TRUE*.

CAN Trigger

Example 1: Set the cycle time via a CAN message 2/2



Now the short command for setting the cycle time needs to be entered in the *Action* string. Remember, the value of the received message can be used as *%v*.

Referring to the users manual, the short command is: CYCL <Time> with the allowed values 0.03 … 60.

→ Action: *CYCL %v;*

After setting the State to On, the LMG will instantaneously start to read from the CAN bus and to execute the defined command.

CAN Trigger

Example 2: Set the current range depending on the reading 1/3

Assumed situation: We assume to measure a current of 20Arms at power channel 1 but sporadic voltage peaks of >60A and <120A. When the LMG detects this peak value it automatically would set the range to the next appropriate: 32A range.

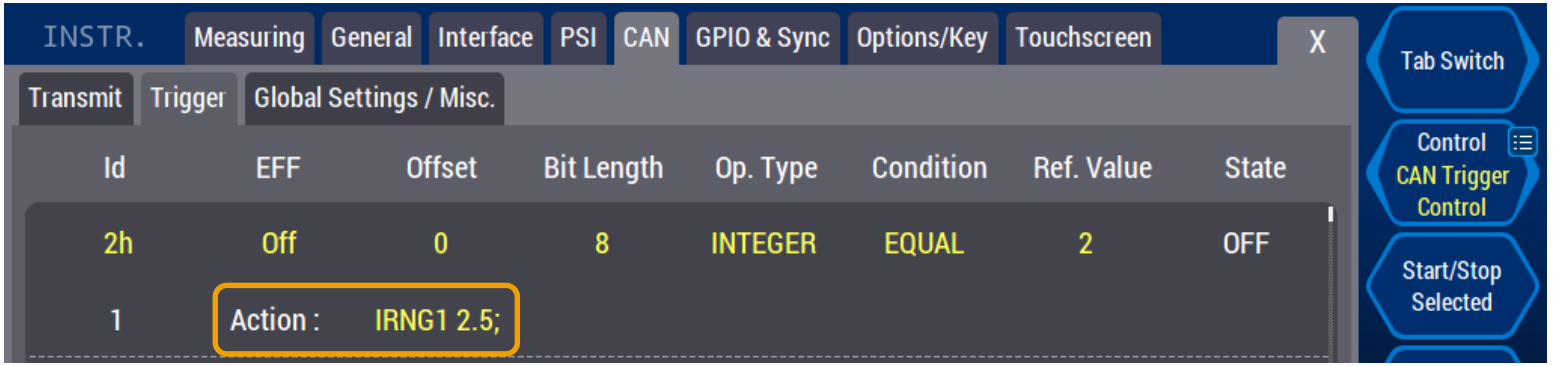
Note: A range change means a gap in the measurement. Therefore the *range* is at first set to *Manual* and *20A*.

But the device under test is having different voltages due to different operation modes. At first 20Arms and then only 2Arms. As soon as the 2A operation mode is present, the range shall be set down to 2.5A to ensure highest accuracy.
The system is sending the operation mode (20, 2) as a separate CAN message on Id 2.

→ The range shall be set manually by the user via a CAN message:
- Either as shown in example for setting the cycle time (the user must enter the value)
- **Or triggered on the operation mode: CAN Id 2**

CAN Trigger

Example 2: Set the current range depending on the reading 2/3



Now the short command for setting the current range needs to be entered in the *Action* string.

Referring to the users manual, the short command is: IRNG <Nrf> with the allowed values as specified in the datasheet for direct input I*.

→ Action: *IRNG1 2.5;*

The condition is: execute the command if the received value is equal 2.

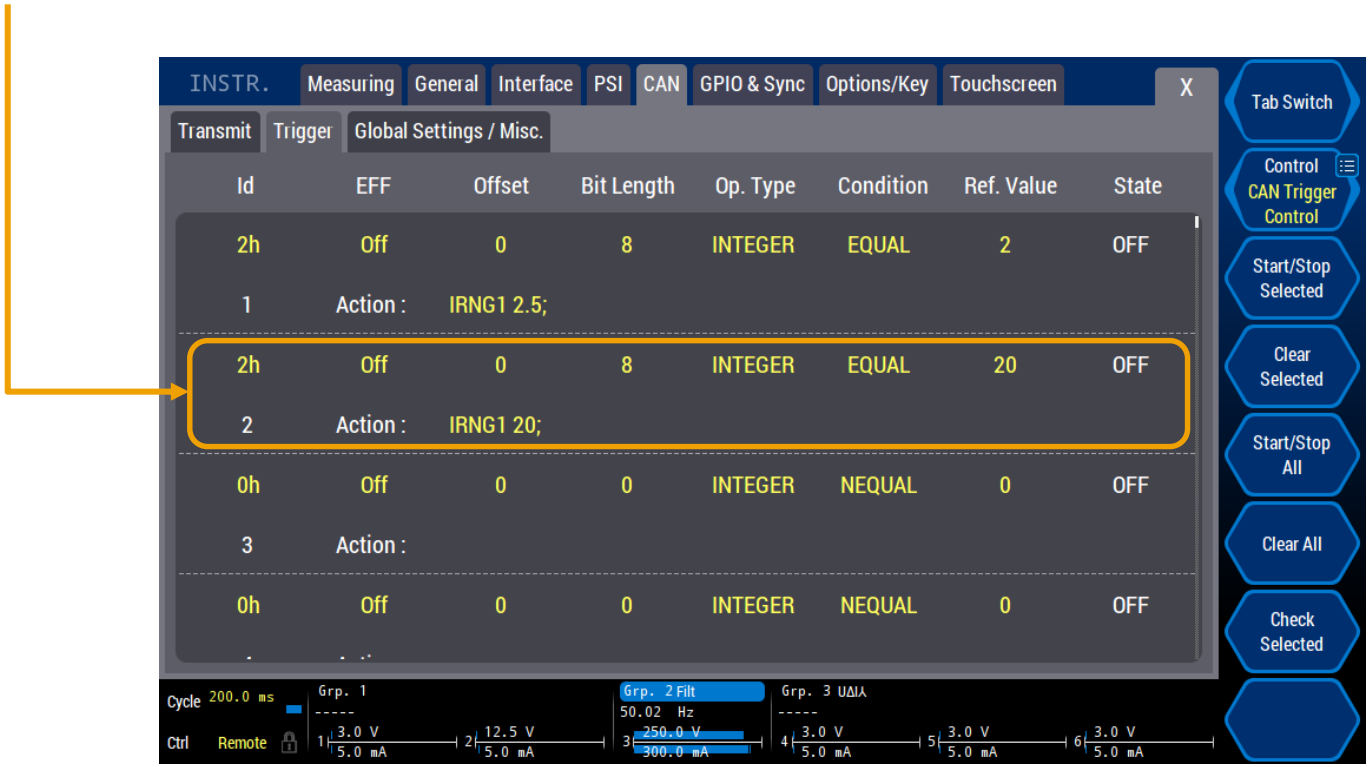
*A second trigger condition could be to set the range too 20A, if the received value is 20.

ZES ZIMMER
Precision Power Measurement

CAN Trigger

Example 2: Set the current range depending on the reading 3/3

A second trigger condition could be to set the range to 20A, if the received value is 20.



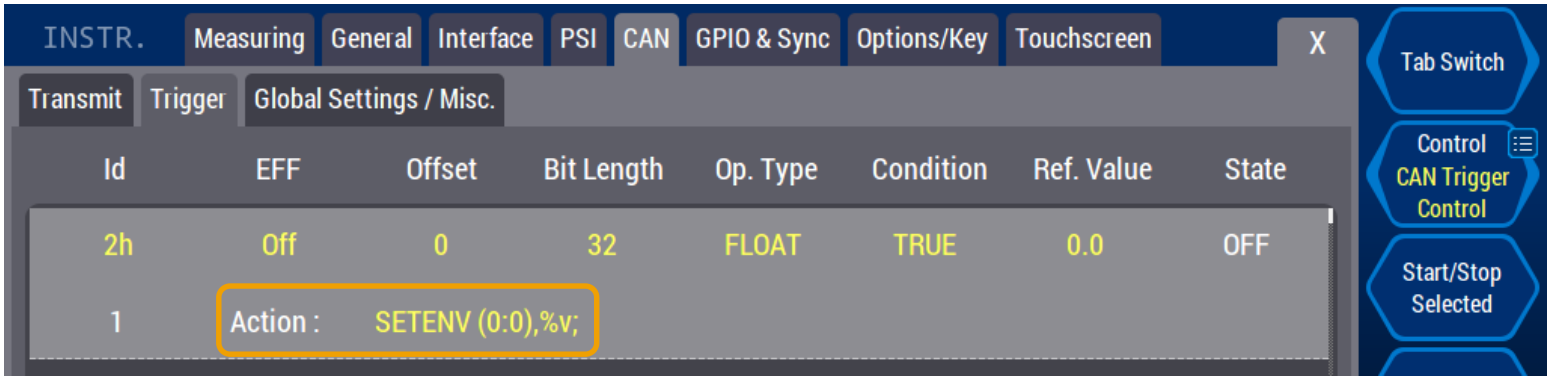
ZES ZIMMER
Precision Power Measurement

CAN Trigger

Example 3: Set an environment variable 1/2

The CAN Trigger facilitates to set the 128 available environment variables with the value received via a CAN message. These environment variables can be assigned to script variables and finally logged into a logfile.

This means, values from other CAN participants like temperature sensors or alike can be logged as well in parallel to the power analysis measurands. In this example, the first environment variable will be set to the float value received from CAN Id 1.

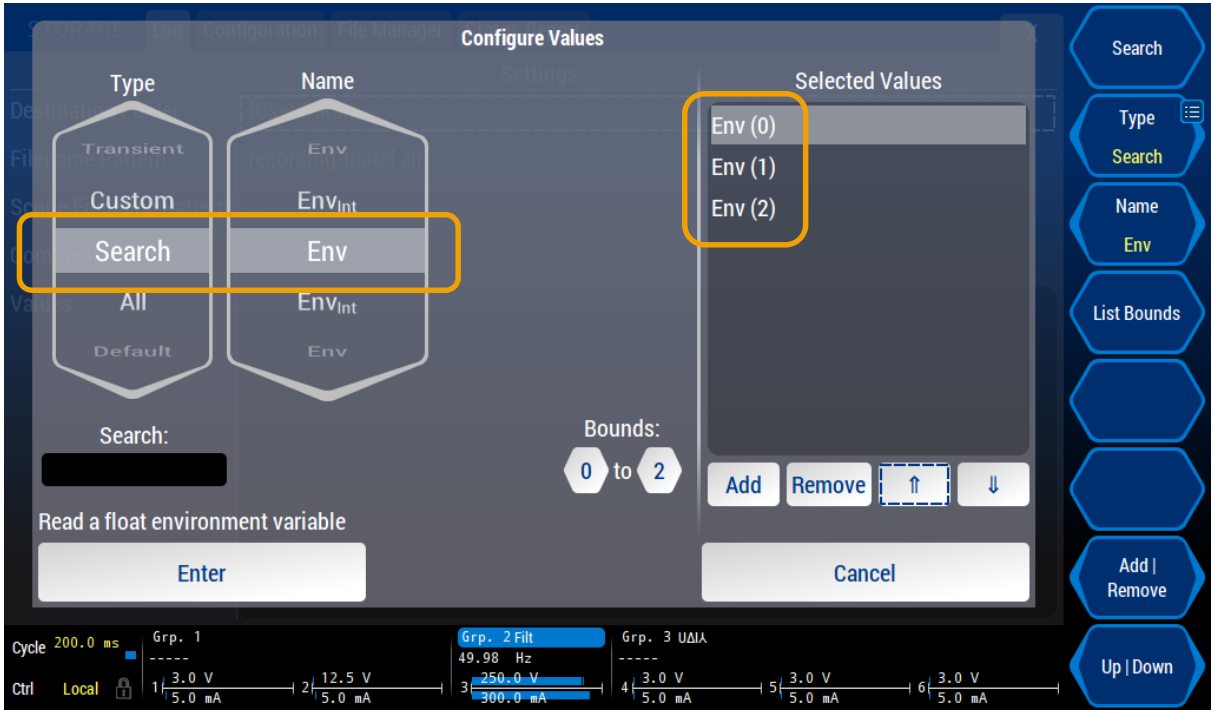


→ Action: *SETENV (0:0),%v;*

ZES ZIMMER
Precision Power Measurement

CAN Trigger

Example 3: Set an environment variable 2/2



The environmental variable to which the received value can be selected in the STORAGE menu to be logged in parallel to the usual measurands.

<STORAGE> Menu → *Log* → **Configure Values**

ZES ZIMMER
Precision Power Measurement

1 CAN Feature

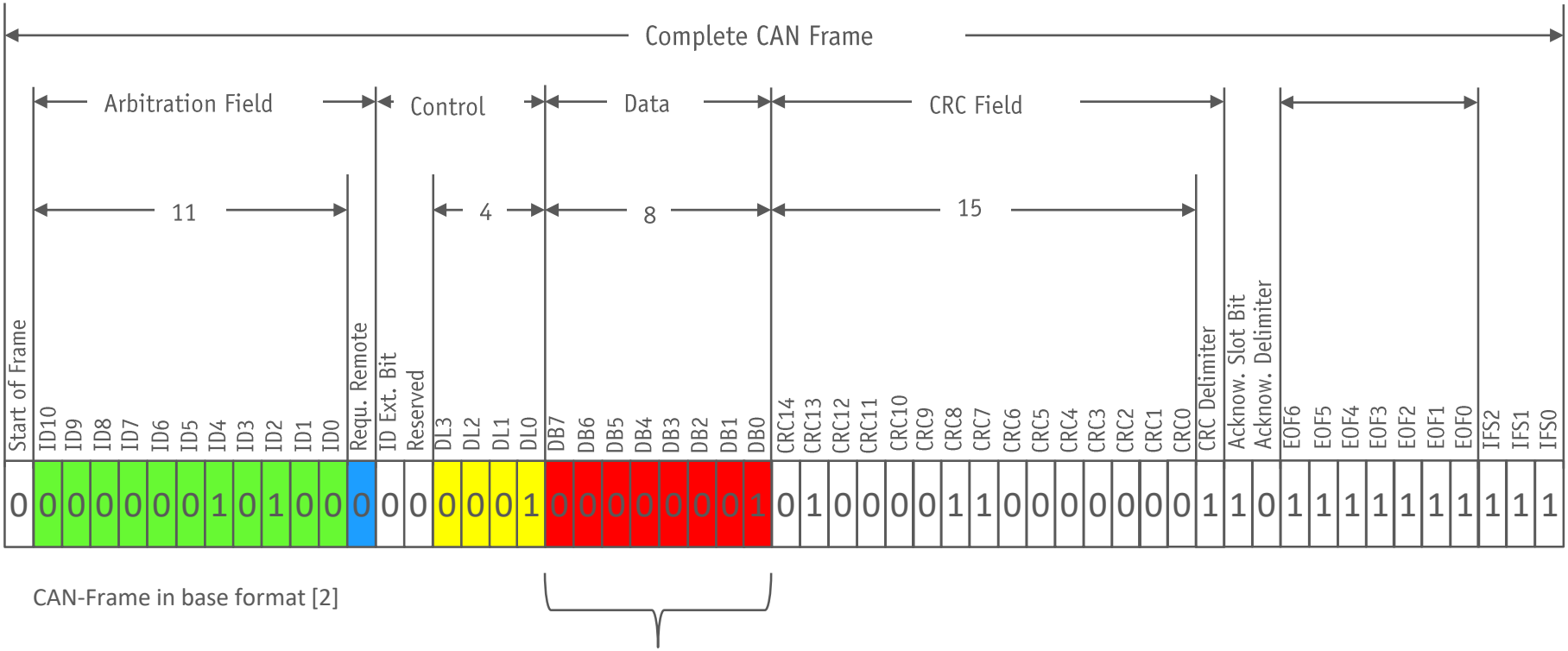
2 CAN Transmission

3 CAN Trigger

4 Appendix

Appendix

Base CAN frame format



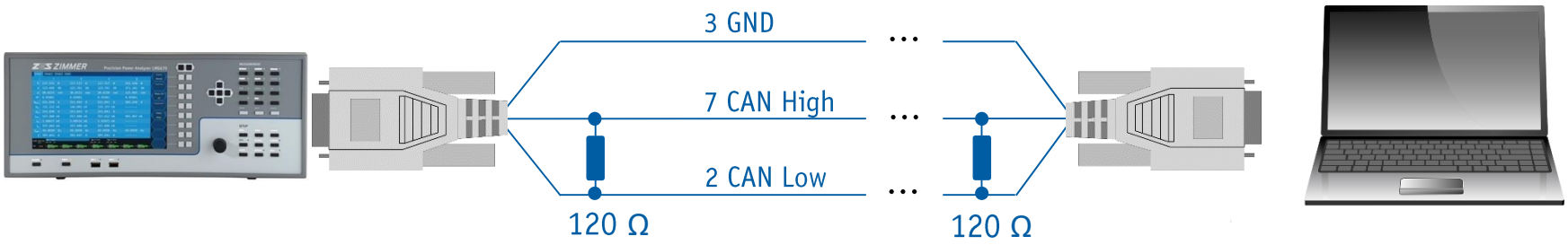
CAN-Frame in base format [2]

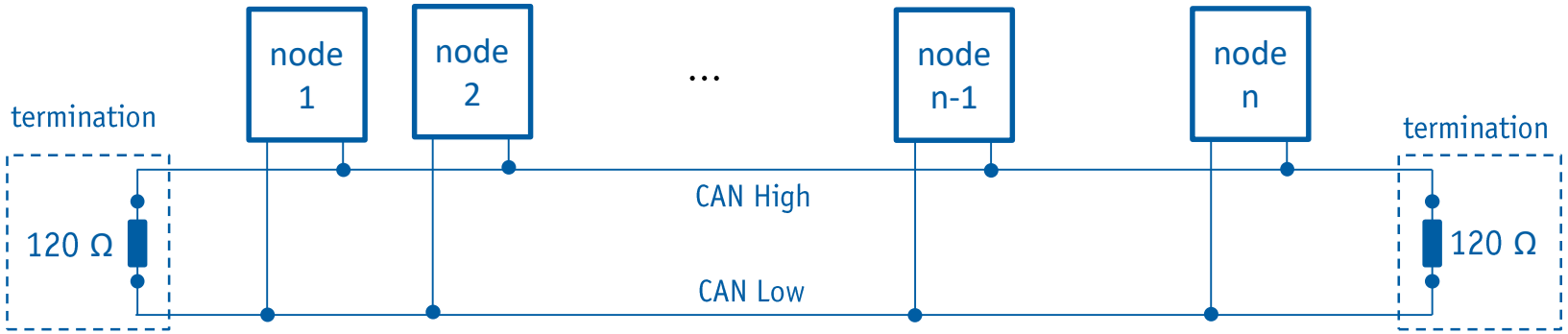
ZES ZIMMER
Precision Power Measurement

Appendix

BUS termination

There is no internal termination, therefore, the device must be used on a terminated bus. This means either using a bus cable with terminating resistors of 120 Ohm between CAN-H and CAN-L or connecting the LMG with a usual serial cable to a terminated bus network.

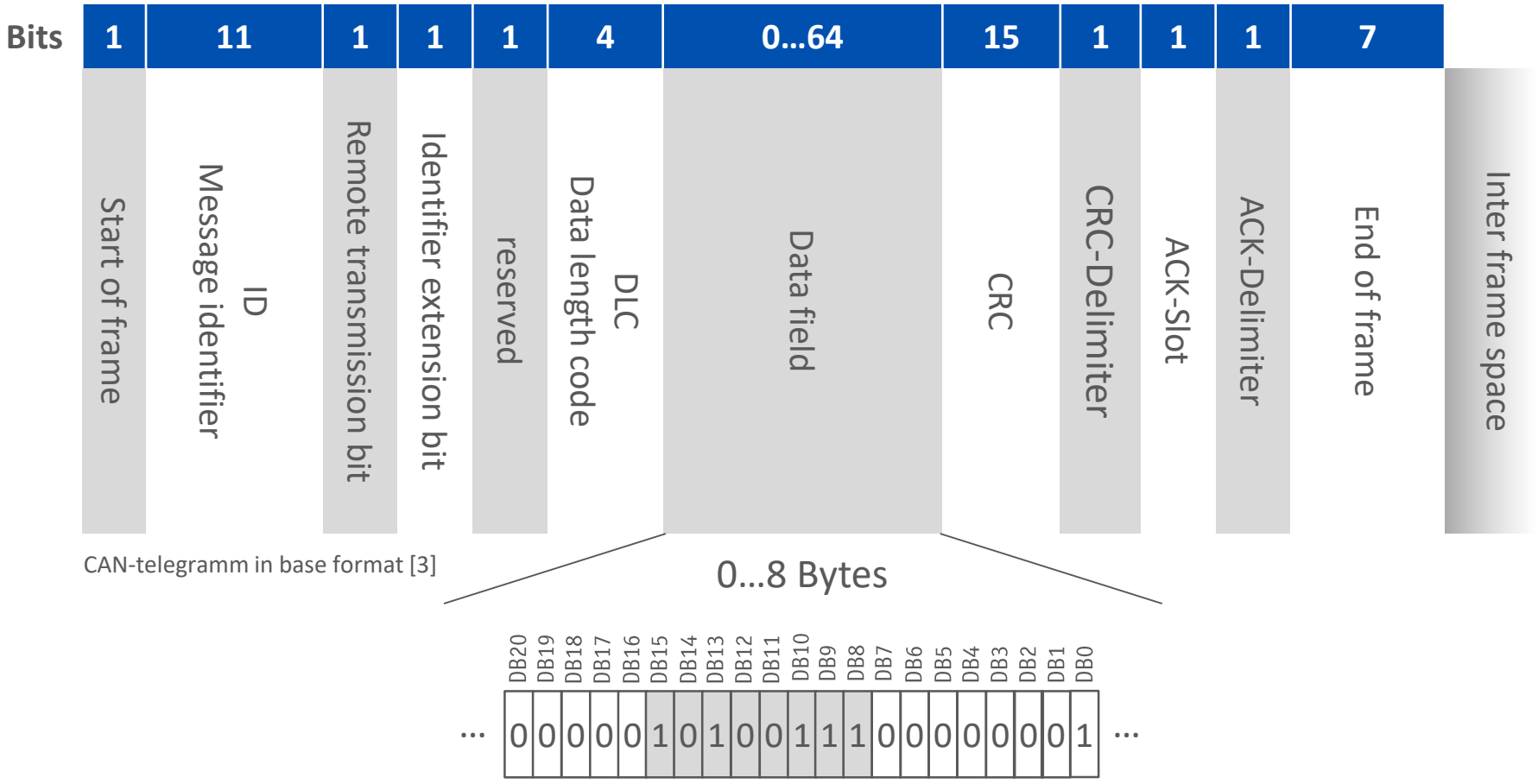




ZES ZIMMER
Precision Power Measurement

Appendix

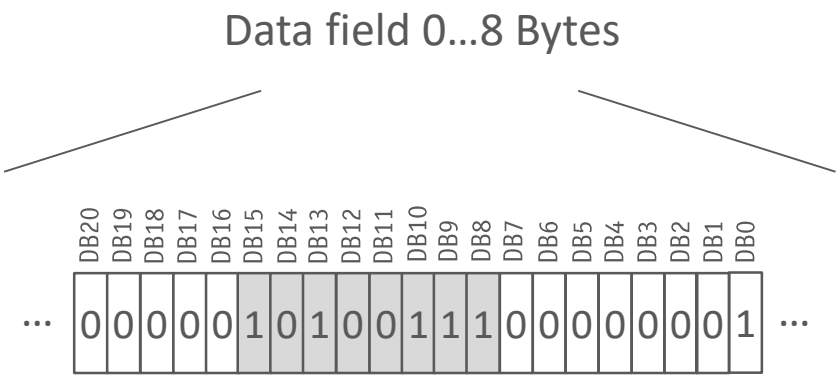
Base CAN frame format



ZES ZIMMER
Precision Power Measurement

Appendix

Offset and bit length in the CAN Trigger menu



Actual value to be received in the CAN message in the data field from bit 9 and a length of 8 bits (1 byte):

→ *Offset* = 8

→ *Bit Length* = 8

Appendix

Useful

Links:

LMG670 Precision Power Analyzer

LMG640 Precision Power Analyzer

LMG610 Precision Power Analyzer

Application Notes

Latest Firmware LMG600 Series

News: Bi-directional CAN Interface – Remote Control via CAN

References:

[1] ZES ZIMMER: Newsletter: Bi-directional CAN Interface – Remote Control via CAN

[2] en.m.Wikipedia.org: CAN bus

[3] de.m.Wikipedia.org: Controller Area Network

M.Sc. Patrick Fuchs
ZES ZIMMER Electronic Systems GmbH
Sales and Application
pfuchs@zes.com
+49 (0) 6171 6287-71
www.zes.com

Precision Power Analyzers

Precision High Voltage Dividers

Precision Current Sensors

All you need to analyze power

ZES ZIMMER
Precision Power Measurement