TEMPOSONICS®

R – Series 2004

CANbasic – Output C101

Operating Manual

Configuration and
CAN-Bus Coupling

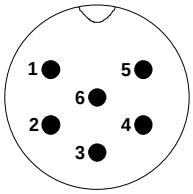
Operational manual CANbasic C101

RP-x-xxxxM-D6x-1-C101-xx1
RH-x-xxxxM-D6x-1-C101-xx1
RP-x-xxxxM-Pxx-1-C101-xx1
RH-x-xxxxM-Pxx-1-C101-xx1

release: 09/04

Connecting diagram:

1 – gray - CAN_L (dominant low)
2 – pink - CAN_H (dominant high)
5 – brown - +24V DC
6 – white - 0V



List of Commands, Data Length codes and Data formats

Parameter	Function	COB-Id	DLC	Command/Data
Broadcastmessage	Node Start	Broadc. Id.	2	01, 00 (for all nodes)
			2	01, NId (only for one node)
Broadcastmessage	Node Stop	Broadc. Id.	2	02, 00 (for all nodes)
			2	02, NId (only for one node)
Nodeidentifier	request	2021 (7E5)	5	01, SS, SS, SS, SS
	program	2021 (7E5)	6	02, SS, SS, SS, SS, NId
Positionidentifier	request	2026 (7EA)	2	NId, 01
	program	2026 (7EA)	4	NId, 02, XX, XX
Broadcastidentifier	request	2026 (7EA)	2	NId, 03
	program	2026 (7EA)	4	NId, 04, XX, XX
Limitswitchidentifier	request	2026 (7EA)	2	NId, 05
	program	2026 (7EA)	4	NId, 06, XX, XX
Operational mode	request	2026 (7EA)	2	NId, 07
and protocol	program	2026 (7EA)	3	NId, 08, XX
Sampling rate	request	2026 (7EA)	2	NId, 09
	prog. PROM	2026 (7EA)	3	NId, 0A, XX
	prog. RAM	2026 (7EA)	3	NId, 0B, XX

SS, SS, SS, SS – Serial number (in hex); NId - Nodeidentifier; XX – Userdata (in hex)

Parameter	Function	COB-Id	DLC	Command/Data
Lower static limit	request	2026 (7EA)	2	NId, 0C
	program	2026 (7EA)	3	NId, 0D, XX, XX, XX
Upper static limit	request	2026 (7EA)	2	NId, 0E
	program	2026 (7EA)	5	NId, 0F, XX, XX, XX
Dynamical limit 1	request	2026 (7EA)	2	NId, 10
	program	2026 (7EA)	5	NId, 11, XX, XX, XX
Dynamical limit 2	request	2026 (7EA)	2	NId, 12
	program	2026 (7EA)	5	NId, 13, XX, XX, XX
Dynamical limit 3	request	2026 (7EA)	2	NId, 14
	program	2026 (7EA)	5	NId, 15, XX, XX, XX
Stroke length	request	2026(7EA)	2	NId, 20
Resolution	request	2026(7EA)	2	NId, 22

SS, SS, SS, SS – Serial number; NId - Nodeidentifier; XX – Userdata (in hex)

Explanation of programming

During the installation or the programming of new data the transducer works as a CAN-slave. After each programming instruction the transducer answers with a recognition string so that the PLC can verify if the transducer gets the right information.
During the normal operating the parameter needn't to be programmed after the power up, because the parameter are stored in an EEPROM.

Nodeidentifier

The nodeidentifier is used for the fast and easy response of the CAN clients. Each CAN client gets his own nodeidentifier. This identifier is programmed during installation by using the serial number of the transducer (printed on transducer label). The serial number must be send in the following way:

serial number on transducer label: i.e. FNr.: 04020235

serial number for communication protocol: 04 02 02 35

Requesting the nodeidentifier

Source	COB-ID	Data	Destination
LMT Master	2021	01; SS; SS; SS; SS	LMT Slave
LMT Slave	2020	01; SS; SS; SS; SS; NId	LMT Master

Programming the nodeidentifier

Source	COB-ID	Data	Destination
LMT Master	2021	02; SS; SS; SS; SS; NId	LMT Slave
LMT Slave	2020	02; SS; SS; SS; SS; NId	LMT Master

Positionidentifier

The positionidentifier is the identifier with which the transducer sends his position data on the CAN bus. In CAN-Master mode the position data will be send automatically on the bus. In CAN-Slave mode the position data must be read by using a *remote frame* on the positionidentifier. The positionidentifier determines the priority of the message. A message with a low identifier has higher priority than a message with a high identifier.

Requesting the positionidentifier

Source	COB-ID	Data	Destination
LMT Master	2026	NId; 01	LMT Slave
LMT Slave	2025	NId; 01; xx; xx	LMT Master

Programming the positionidentifier

Source	COB-ID	Data	Destination
LMT Master	2026	NId; 02; xx; xx	LMT Slave
LMT Slave	2025	NId; 02; xx; xx	LMT Master

Broadcastidentifier

The broadcastidentifier is used to send ‘Node Start‘, ‘Node Stop‘ and ‘Node Reset‘ messages to the transducer. Normally the broadcastidentifier is the identifier 000 (based on Can Application Layer CAL), but sometimes it is necessary that the braodcastidentifier is another than the CAL based.

Requesting the broadcastidentifier

Source	COB-ID	Data	Destination
LMT Master	2026	NId; 03	LMT Slave
LMT Slave	2025	NId; 03; xx; xx	LMT Master

Programming the broadcastidentifier

Source	COB-ID	Data	Destination
LMT Master	2026	NId; 04; xx; xx	LMT Slave
LMT Slave	2025	NId; 04; xx; xx	LMT Master

Limitswitchidentifier

The limitswitchidentifier is the identifier with which the transducer sends his status information. In CAN-Master mode the status information will be send automatically when a status change is detected. In CAN-Slave mode the status information must be read by using a *remote frame* on the limitswitchidentifier. The limitswitchidentifier determines the priority of the message. A message with a low identifier has higher priority than a message with a high identifier. (This identifier is only used if this operational mode is selected)

Requesting the limitswitchidentifier

Source	COB-ID	Data	Destination
LMT Master	2026	NId; 05	LMT Slave
LMT Slave	2025	NId; 05; xx; xx	LMT Master

Programming the limitswitchidentifier

Source	COB-ID	Data	Destination
LMT Master	2026	NId; 06; xx; xx	LMT Slave
LMT Slave	2025	NId; 06; xx; xx	LMT Master

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Operational mode and protocol

- *CAN-Master mode*:
  The transducer sends, depending on the sampling period, automatically after measurement the position data on the bus. (B3 = 0 measurement free running)
  CAN-Slave mode: The transducer does the measurement and waits for a remote frame on the positionidentifier to send the position data. (B3 = 0 measurement free running)

- *Extra Limitswitch message*:
  It can be selected if the transducer sends a status information with a separate identifier or not. The status message is an one byte message described at Status information.
  In CAN-Master mode the status message is directly send when a change of the status is detected. This information would be send independent from the sample period of the transducer.
  In CAN-Slave the transducer waits for a remote fame on the limitswitchidentifier to send the status information

- *Velocity calculation:*
  By selection it is possible to measure the velocity of the movement of the magnet. The velocity information is added to the position information. The complete message is send out with the position identifier.

- *Protocol format:*
  There are two kinds of protocol formats available:
  Protocol format M: MSB-Position ... LSB Position, Status (MSB-Velocity, LSB-Velocity)
  Protocol format I : (LSB-Velocity, MSB-Velocity) Status, LSB-Position ... MSB-Position

- *Synchron mode*:
  If Synchron mode is selected the measurement can be started with ‘Node Start’ the transducer receives. After the measurement is finished the transducer sends the position data on the bus and is ready to receive the next ‘Node Start’.
  To use the Synchron mode also CAN-Master must be selected. The maximum time between to ‘Node Start’ messages is 5ms. The minimum time is the cycle time.

Operational mode and protocol

D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	B3	F	B2	B1	B0

B0: 0 = with extra limitswitch message
1 = without extra limitswitch message

B1: 0 = CAN - Master
1 = CAN – Slave

B2: 0 = with velocity calculation
1 = without velocity calculation

F: 0 = Protocol format M
1 = Protocol format I

B3: 0 = measurement free running
1 = measurement synchronous to ‘Node Start’

Requesting the operational mode and protocol

Source	COB-ID	Data	Destination
LMT Master	2026	NId; 07	LMT Slave
LMT Slave	2025	NId; 07; xx	LMT Master

Programming the operational mode and protocol

Source	COB-ID	Data	Destination
LMT Master	2026	NId; 08; xx	LMT Slave
LMT Slave	2025	NId; 08; xx	LMT Master

Sampling Period

Over the sampling period a selection could be made in which time periods the transducer sends its position data. The sampling must be a value between 1 and 255 (0x01 - 0xFF). The value 0 is not allowed. The time period t_{send} could be calculated with the sample s and the cycle time of the transducer as follows:

transducer length: 0 - 1200 mm	$t_{send} = s * 0.5\ ms$
transducer length: 1201 - 2400 mm	$t_{send} = s * 1.0\ ms$
transducer length: 2401 - 4800 mm	$t_{send} = s * 2.0\ ms$
transducer length: 4801 - 9600 mm	$t_{send} = s * 4.0\ ms$

The sampling period can be programmed in the permanent memory (EEPROM) or only in the RAM. Normally there is one sampling period programmed to the EEPROM and during production the sampling period is only changed in the RAM. After power up the transducer the sampling period stored in the EEPROM is automatically written in the RAM.

Requesting the sampling rate

Source	COB-ID	Data	Destination
LMT Master	2026	NId; 09	LMT Slave
LMT Slave	2025	NId; 09; xx	LMT Master

Programming the sampling rate to EEPROM

Source	COB-ID	Data	Destination
LMT Master	2026	NId; 0A; xx	LMT Slave
LMT Slave	2025	NId; 0A; xx	LMT Master

Programming the sampling rate to the RAM

Source	COB-ID	Data	Destination
LMT Master	2026	NId; 0B; xx	LMT Slave
LMT Slave	2025	NId; 0B; xx	LMT Master

Limit switch function

There are 5 limits to program. Two limits are fixed limits; these values are stored in an EEPROM. The other 3 limits are dynamical limits; these values are store in the RAM. The significance of the LSB is depends on the resolution of the transducer.

The limits are compared with the position data and the status of each comparison is send with the status information.

The two static limits (low and high static limit) are security limits. The limit switch function may be programmed but it is not necessary to program them.

Requesting the lower static limit

Source	COB-ID	Data	Destination
LMT Master	2026	NId; 0C	LMT Slave
LMT Slave	2025	NId; 0C; xx; xx; xx	LMT Master

Programming the lower static limit

Source	COB-ID	Data	Destination
LMT Master	2026	NId; 0D; xx; xx; xx	LMT Slave
LMT Slave	2025	NId; 0D; xx; xx; xx	LMT Master

Requesting the upper static limit

Source	COB-ID	Data	Destination
LMT Master	2026	NId; 0E	LMT Slave
LMT Slave	2025	NId; 0E; xx; xx; xx	LMT Master

Programming the upper static limit

Source	COB-ID	Data	Destination
LMT Master	2026	NId; 0F; xx; xx; xx	LMT Slave
LMT Slave	2025	NId; 0F; xx; xx; xx	LMT Master

Requesting the dynamical limit 1

Source	COB-ID	Data	Destination
LMT Master	2026	NId; 10	LMT Slave
LMT Slave	2025	NId; 10; xx; xx; xx	LMT Master

Programming the dynamical limit 1

Source	COB-ID	Data	Destination
LMT Master	2026	NId; 11; xx; xx; xx	LMT Slave
LMT Slave	2025	NId; 11; xx; xx; xx	LMT Master

Requesting the dynamical limit 2

Source	COB-ID	Data	Destination
LMT Master	2026	NId; 12	LMT Slave
LMT Slave	2025	NId; 12; xx; xx; xx	LMT Master

Programming the dynamical limit 2

Source	COB-ID	Data	Destination
LMT Master	2026	NId; 13; xx; xx; xx	LMT Slave
LMT Slave	2025	NId; 13; xx; xx; xx	LMT Master

Requesting the dynamical limit 3

Source	COB-ID	Data	Destination
LMT Master	2026	NId; 14	LMT Slave
LMT Slave	2025	NId; 14; xx; xx; xx	LMT Master

Programming the dynamical limit 3

Source	COB-ID	Data	Destination
LMT Master	2026	NId; 15; xx; xx; xx	LMT Slave
LMT Slave	2025	NId; 15; xx; xx; xx	LMT Master

Stroke length

The stroke length gives information about the usable measuring range of the transducer in [mm].

Requesting the stroke length

Source	COB-ID	Data	Destination
LMT Master	2026	NId; 20	LMT Slave
LMT Slave	2025	NId; 20; xx; xx	LMT Master

Resolution

The resolution of the transducer is given in [µm]. The command is only for information.

Requesting the resolution

Source	COB-ID	Data	Destination
LMT Master	2026	NId; 22	LMT Slave
LMT Slave	2025	NId; 22; xx; xx	LMT Master

Node Start / Node Stop Protocol

The 'Node Start' message is used to switch the transducer active; the 'Node Stop' message will switch the transducer passive. Therefore the nodeidentifier of the transducer is need. Also with the 'Node Start / Node Stop' messages all transducers could be switched active / passive at the same time. Therefore the nodeidentifier 00 is necessary.

Example of Node Start

Source	COB-ID	Data		Destination
NMT Master	Broadc.Id.	01; 00	(for all)	NMT Slave
NMT Master	Broadc.Id.	01; NId	(for one)	NMT Slave

Example of Node Stop

Source	COB-ID	Data		Destination
NMT Master	Broadc.Id.	02; 00	(for all)	NMT Slave
NMT Master	Broadc.Id.	02; NId	(for one)	NMT Slave

Position message format without velocity calculation

The data format can be protocol format M or protocol format I.

Protocol format M

Indent.	DLC	D0	D1	D2	D3
Pos.Id.	4	Highbyte Position	Med.byte Position	Lowbyte Position	Status

Protocol format I

Ident.	DLC	D0	D1	D2	D3
Pos.Id.	4	Status	Lowbyte Position	Med.byte Position	Highbyte Position

Together with the position there also the status of the transducer and the limitswitch comparison is send out. The significance of the position-LSB is 5, 2 or 1 µm.

Position message format with velocity calculation

The data format can be protocol format M or protocol format I.

Protocol format M

Ident.	DLC	D0	D1	D2	D3	D4	D5
Pos.Id.	6	Highbyte Position	Med.byte Position	Lowbyte Position	Status	Highbyte Velocity	Lowbyte Velocity

Protocol format I

Ident.	DLC	D0	D1	D2	D3	D4	D5
Pos.Id.	6	Lowbyte Velocity	Highbyte Velocity	Status	Lowbyte Position	Med.byte Position	Highbyte Position

Together with the position there also the status of the transducer and the limitswitch comparison and also the velocity is send out. The resolution of the position respects to the ordering guide. The resolution of the velocity depends on the resolution of the position and the measured velocity itself and changes automatically.

Resolution of velocity (resolution of position data: **0.005mm):**

the significance of LSB is constant 1,00 (0,50; 0,25) mm/s

Velocity [mm/s]	Resolution [mm/s]	Timeintervall [ms]
V > 640	10,00 (5,00 ; 2,50)	0,5 (1,0 ; 2,0)
640 > V > 320	5,00 (2,50 ; 1,25)	1,0 (2,0 ; 4,0)
320 > V > 213	3,33 (1,66 ; 0,83)	1,5 (3,0 ; 6,0)
213 > V > 128	2,00 (1,00 ; 0,50)	2,5 (5,0 ; 10,0)
128 > V > 0	1,00 (0,50 ; 0,25)	5,0 (10,0 ; 20,0)

The values in brackets are in response to transducer length more than 1,2 respectively 2,4m

Resolution of velocity (resolution of position data: **0.002mm):**

the significance of LSB is constant 0,40 (0,20; 0,10) mm/s

Velocity [mm/s]	**Resolution [mm/s]**	**Timeintervall [ms]**
V > 640	4,00 (2,00 ; 1,00)	0,5 (1,0 ; 2,0)
640 > V > 320	2,00 (1,00 ; 0,50)	1,0 (2,0 ; 4,0)
320 > V > 213	1,20 (0,60 ; 0,30)	1,5 (3,0 ; 6,0)
213 > V > 128	0,80 (0,40 ; 0,20)	2,5 (5,0 ; 10,0)
128 > V > 0	0,40 (0,20 ; 0,10)	5,0 (10,0 ; 20,0)

The values in brackets are in response to transducer length more than 1,2 respectively 2,4m

The Status information looks like follows:

B7	B6	B5	B4	B3	B2	B1	B0
x	SE	DL3	DL2	DL1	UL	LL	ST

ST:	Status Transducer	0 = transducer ok
		1 = transducer failure
LL:	Status Lower Limit	0 = position > lower limit
		1 = position < lower limit
UL:	Status Upper Limit	0 = position < upper limit
		1 = position > upper limit
DL1:	Status Dynamical Limit 1	0 = position < dynamical limit 1
		1 = position > dynamical limit 1
DL2:	Status Dynamical Limit 2	0 = position < dynamical limit 2
		1 = position > dynamical limit 2
DL3:	Status Dynamical Limit 3	0 = position < dynamical limit 3
		1 = position > dynamical limit 3
SE:	Status EEPROM	0 = Checksum ok
		1 = Checksum failure

LED definitions:

Green	Red	Indication
Off	Off	No supply voltage present
Off	On	Transducer start-up failure
On	Off	Normal transducer operation, (acceptable supply voltage is present, position magnet within active stroke range, no problems detected
On	On	Position magnet is not detected or missing
Flashing	Flashing	Supply voltage is nearly beyond the acceptable limits. If voltage is low the transducer is still operating, but the supply voltage should be corrected to assure continued operation. If the voltage is high the transducer is still operating, but the transducers over-voltage protection may engage, powering off the transducer temporarily. The over-voltage should be corrected to assure continued operation and avoid possible permanent damage.

Default values: for Standard CAN transducers with C101 Protocol :

- Nodeidentifier 0x00
- Positionsidentifier 0x0100
- Broadcastidentifier 0x0000
- Limitswitchidentifier 0x07FF
- Operational Mode 0x00
- Sampling Period 0x01
- Lower static limit 0x00FFFFFF
- Upper static limit 0x00FFFFFF

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Document Part Number:
BA R2004 CANbasic C101e-043701PL

CE ISO 9001 CERTIFIED

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