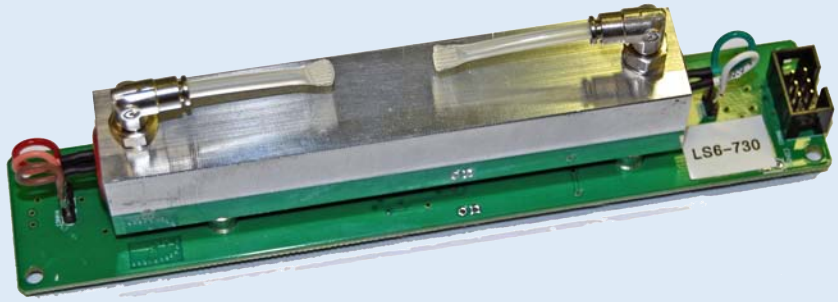
HIGH SENSITIVITY NDIR SENSORS
for
Gas Leak Detection



LS series
(release 11/01/2023)

PRODUCT HIGHLIGHTS
100PPM or 1000PPM full range scale
Fast response (down to 0.5s)
Very low minimum detection limit (e.g. : 0.2 PPM SF6, 0.5PPM CO2)
Wide spectrum of detectable gases
Thermal drift compensation
Easy to integrate in OEM systems

APPLICATION
HVAC Industry
High Voltage Electric Gas Isolation Testing
Environmental monitoring

Qbit Srl - via Vittorio Veneto 8/3 - 51039 Quarrata (PT)
sales@qbit-optronics.com

Contents

Introduction

"LS" series sensors are designed for "trace gas detection" applications. This means that they are developed to reach the highest speed and resolution. They are based on a single I.R. channel scheme to obtain maximum sensitivity. Thus they are mostly indicated for the detection of small gas leaks. In spite of that their considerable stability permits other applications when a periodic background radiation reset is accessible. These sensors have been extensively applied in the HVAC Industry for refrigerant gas leak detection and in the field of High Voltage Electric Isolation device seal testing where isolating gases like SF_6 are adopted.

List of available LS sensors

Standard sensors:

	Detected Gases:
Sensor LS-3	**CO_2**
Sensor LS-5	**R134, R404 , R407, R410, R22, R1234yf**
Sensor LS-6	**HC: CH_4, C_2H_6, C_3H_8 (R290), C_4H_{10} (R600) - C_2H_4O**
Sensor LS-7	**SF_6 , NH_3 (high Concentrations), C_2H_4**

Special sensors: *(available for orders in large lots)*

	Detected Gases:
Sensor LS-1	**R134 (low interference from other refrigerants)**
Sensor LS-2	**R22 (low interference from other refrigerants)**
Sensor LS-4	**R134, R404 , R407, R410**
Sensor LS-8	**CH_4 (low interference from other HC)**
Sensor LS-9	**NH_3 (low Concentrations)**
Sensor LS-N	**Novec 4710, 5110**
Sensor LS-S	**C_2H_2**
Sensor LS-F	**SO_2F_2**
Sensor LS-E	**SOF_2**
Sensor LS-U	**SO_2**

Other gases available on request.

Sensor Specifications

Sensor performances and settings:

Smallest detectable leak rate (for a standard 120 sccm flow rate)	R 134	0.2 (g/y)
	R 22	0.4 (g/y)
	R 404	0.2 (g/y)
	R 407	0.4 (g/y)
	R410	0.5 (g/y)
	R600	0.5 (g/y)
	R290	0.5 (g/y)
Smallest detectable Concentration	CO_2	0.5 PPM
	CH_4	2.0 PPM
	SF_6	0.2 PPM
HIGH res. Measuring scale	0 -100 (g/y) 0 -100 (PPM)	res. 0.1 g/y res. 0.1 PPM
LOW res. Measuring scale	0 -1000 (g/y) 0 - 10000 (PPM)	res. 1 g/y res. 10 PPM
Response time	0.5-1.5 (sec) (1)	
Recommended Gas flow	120 sccm (2)	

(1) the sensor response time can be set on customer demand. A faster response time means a lower detector precision.
(2) Sensor parameters are factory set for this flow rate. Different settings available on demand.

Operational Specifications

General Specifications

Measuring Principle	NDIR (Non dispersive Infra Red)
Measured Gas	See sensor table
Measuring Range	0.0 - 99.9
Measuring Accuracy	See sensor table
Measurement scales	PPM , g/y , 10^{-6} cc/sec (°)
Resolution	0.1
Response time	1 s (*)
Warm-up Time	10-30 min (+)
Operating temperature Range	0 ~ 55 °C
Storage Temperature Range	-20 ~ 85 °C
Operating Humidity Range	0 ~ 90% (non condensing)
Size	160 x 40 x 30 mm including gas connectors

(°) *g/y and cc/sec scales referring to a standard 120 sccm flow.*
(*) *Other measuring times available on request*
(+) *Sensors are immediately working. Warm-up time ranges from 10 to 30 minutes, depending on the sensor type.*

Electrical Specifications

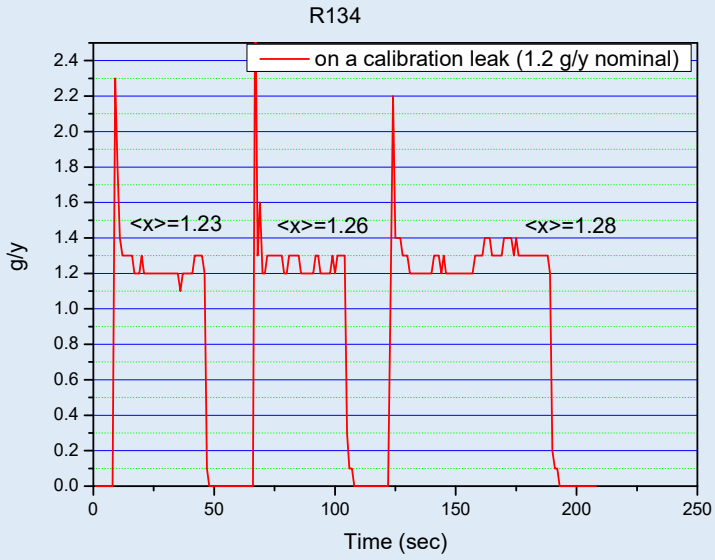
Supply voltage	5V (+/- 5%)
Power consumption	Average 0.7 W (peak current <250 mA)
Communication Interface (ASCII data)	Standard UART 9600 (**)

(**) Baud-rate=9600 (it can be differently set on customer demand), Data bits=8, Parity=none, Stop bits=1.

Measurements accuracy and repeatability

Sensor	***Detected gas***	***Accuracy***
LS3	CO_2	0.2 PPM
LS4	R134 R404 R407 R410	0.1 g/y 0.1 g/y 0.2 g/y 0.3 g/y
LS5	R134 R404 R407 R410 R22	0.2 g/y 0.1 g/y 0.3 g/y 0.4 g/y 0.2 g/y
LS6	Hydrocarbons	1 PPM CH_4 0.3 g/y Iso-Butane (R600) 0.3 g/y Propane (R290)
LS7	SF_6	0.1 PPM

Accuracy and repeatability are substantially the same as testified by the following graph showing three successive measurements of a calibrated leak.



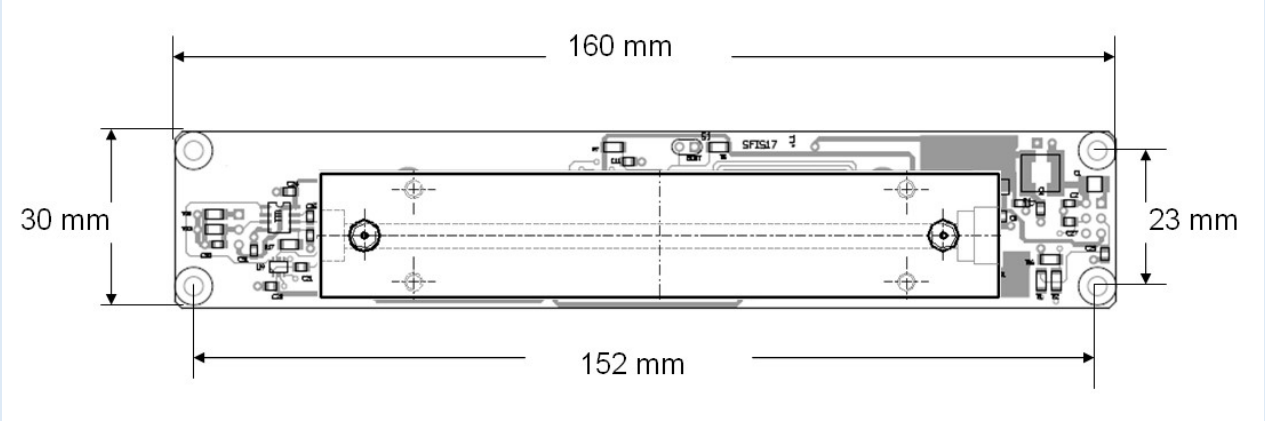
WARM-UP:

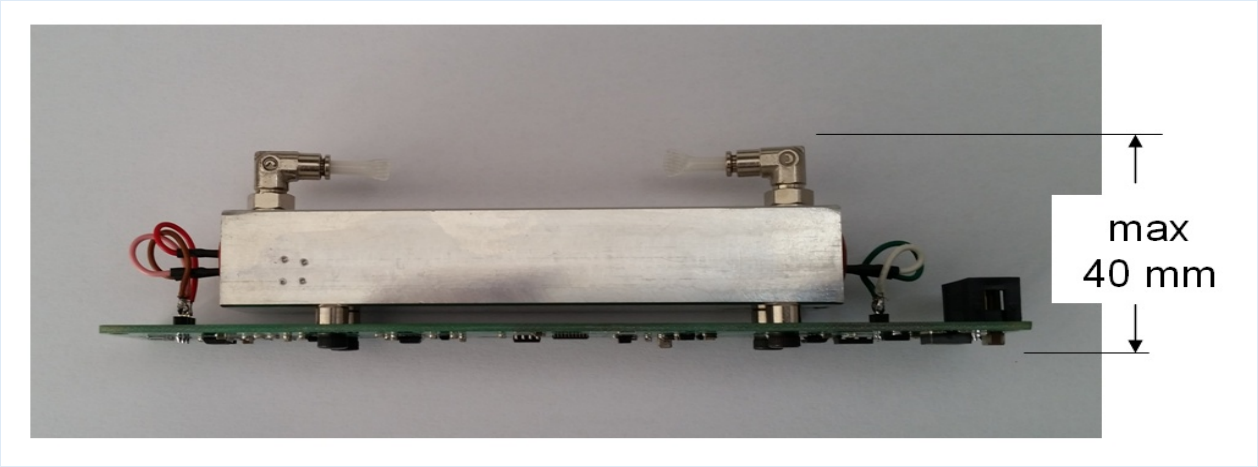
- The sensor can be used immediately after power-on.

It will warm-up in about 10-30 minutes, depending on the sensor type. During this period frequent calibration may be necessary to counteract I.R.-background variations. The optimal warm-up time should be determined depending on the different gas detectors and environmental conditions.

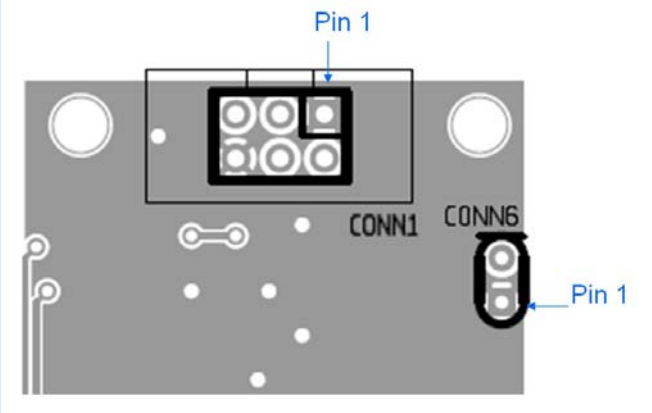
- Precise measures are recommended after 20 minutes from the warm-up cycle.

Mechanical drawings





Connectors



(sensor side)

Connector 1

Pin #1: GND
Pin #2: P.S. +5V (or +5V out if P.S. connected to connector 6)
Pin #3: UART RX (sensor)
Pin #4: UART TX (sensor)
Pin #5: 3.3V out
Pin #6: GND

Connector 6

Pin #1: GND
Pin #2: P.S. +5V

CAUTION:

- Avoid any liquid, moisture and dust to enter the optical cell. The optical cell should be protected by an appropriate filtering stage.
- Prevent not-grounded conductors to touch the aluminum body of the optical cell. Infrared components may be permanently damaged by ESD or any external voltage.

Sensor command list

(commands are sent in plain ASCII code followed by <CR><LF>)

INPUT	COMMAND DESCRIPTION	SENSOR OUTPUT
M	**Sensor Model:**	Sensor answers with its type and serial number. (e.g. **S4-033** for sensor LS-4 s/n 033)
r	**Reset processor**: carries out diagnostics and sets parameters to factory values.	Sensor answers **rok** in case of positive diagnostics.
c	**Calibration: (precise)** carries out a manual zero setting (to be done in clean air) lasts typically 2 seconds.	Sensor answers **cok** at the end of the calibration procedure.
d	**Detector zeroing: (fast)** carries out a fast zero setting(to be done in clean air) lasts typically 1 second.	Sensor answers **dok** at the end of the calibration procedure.
l	**Fast Measurement:** gas detection command with the fastest response. In the standard configuration the sensor answers in 0.5 seconds.	Sensor answers with a three digit string corresponding to the measured gas leak or concentration in the selected resolution scale. In case of abnormal signal levels the string may contain a warning code (**W01…W04).** (See "Error and Warning message List").
h	**Averaged Measurement:** Most precise gas measurement command. . In the standard configuration the sensor answers in 2 seconds.	Sensor answers with a three digit string corresponding to the measured gas leak or concentration in the selected resolution scale. (Possible answers same as above.)
sc	**Scale selection command:** This command switches from a low range scale (higher resolution) to a high range scale (lower resolution)	The string "**sc 0**" selects the low range (high resolution) scale. [The sensor answers echoinig the string "**sc 0**"] The string "**sc 1**" selects the high range (low resolution) scale. [The sensor answers echoinig the string "**sc 1**"] The simple command "**sc**" gets an answer from the sensor (either "**sc 0**" or " **sc 1**") indicating the presently selected scale. The scale is maintained until a new selection is made, even if a reset command is sent or a switch off of the sensor takes place. [For the scale range and resolution. Please refer to each single sensor "test report sheet".]
start	**Continuous measurement mode:** This command allows a continuous measuring session, calling a sequence of "l" commands. The signal output from the sensor is displayed continuously every measuring cycle (standard 30 sec). This operating mode can be interrupted by the **stop** command.	Sensor answers **startok** followed by a series of four digit strings (always ended by a <CR><LF> sequence).These strings correspond to the measured gas concentrations. (Possible answers same as above.)
stop	**Terminate continuous meas. mode:** This command terminates the continuous measuring session activated by the command **start**.	Sensor answers **stopok**

ric	**Scale recalibration:** This command allows to correct the span of the sensor scale .	If called without a value, the sensor answers with the value in memory. If called followed by a value, the sensor will put in memory the new value. (please check the "Scale recalibration Procedure" in the following paragraph).
FOR MULTIPLE GAS SENSORS ONLY (LS-4 and LS-5)		
g1 **g2** **g3** **g4** **g5**	**Gas selection:** detected gas parameters selection g1 → **R134** g2 → **R404** g3 → **R407** g4 → **R410** [g5 → **R22**]	Sensor answers with an acknowledge string (**g1ok**, **g2ok**, **g3ok, g4ok** or **g5ok**). After power-on or a reset cycle, the sensor is always set on parameters of gas **g1** (R134).

IMPORTANT NOTE: after the sensor is turned on, it is always necessary to obtain a current background rejection before measuring. This can be done using either the "c" or the "d" command.

Error & Warning message List

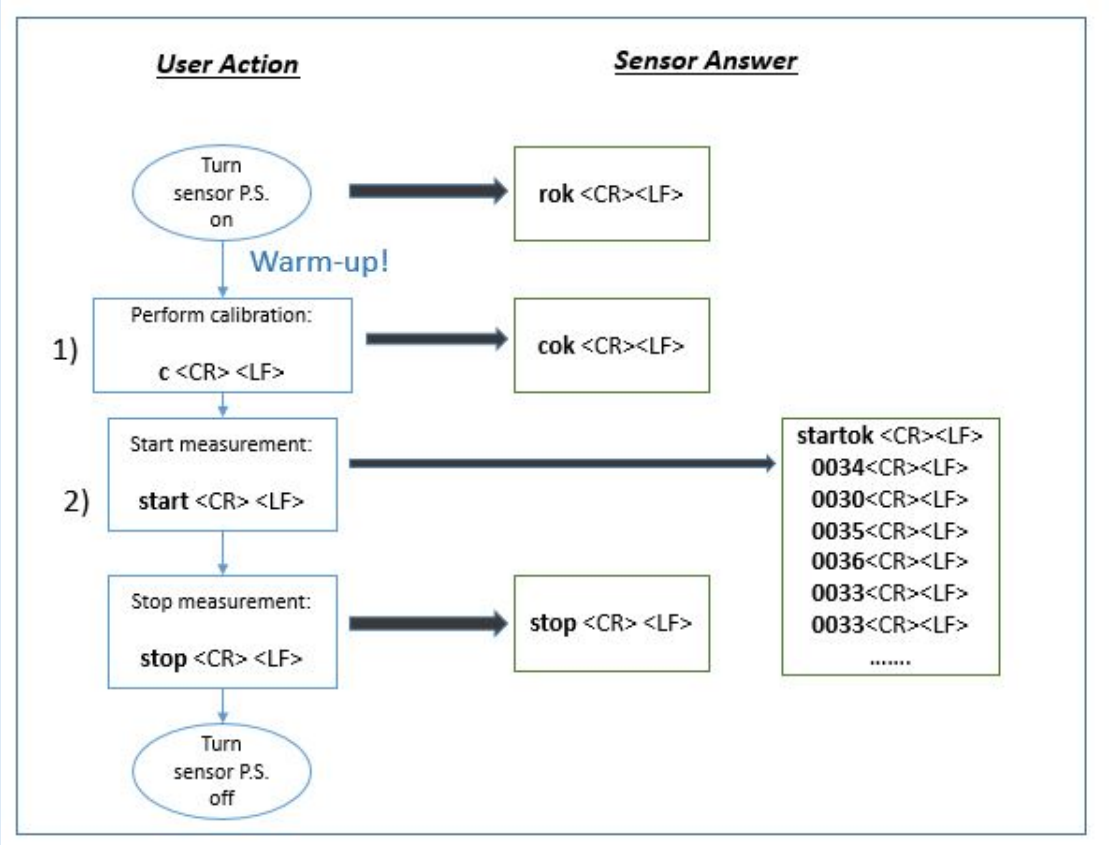
Error/Warning Message	Meaning	Counter-measure
E01	Low level H.W. fault.	Contact factory
E02	Very low Infrared signal	Contact factory
W01	Infrared detector signal is too low. (measurements can be performed anyway).	Sensor is still working. Please repeat one reset cycle. If the problem persists sensor needs revision.
W02	Calibration took place in a polluted environment or was performed too long ago.	Please perform a new calibration cycle in a clean air.
W04	Measurements performed (either with an "h" or "l" Command Call) without a calibration	Please perform a calibration (calling a "c" or "d" command).

Standard Measuring Procedure

The previously described commands are to be used in precise sequences in order to determine a correct measurement procedure. Standard measuring procedures are sketched in the flow-charts that follow.

The first flow-chart shows the most common procedure, that determines a continuous operation of the gas-sensor.

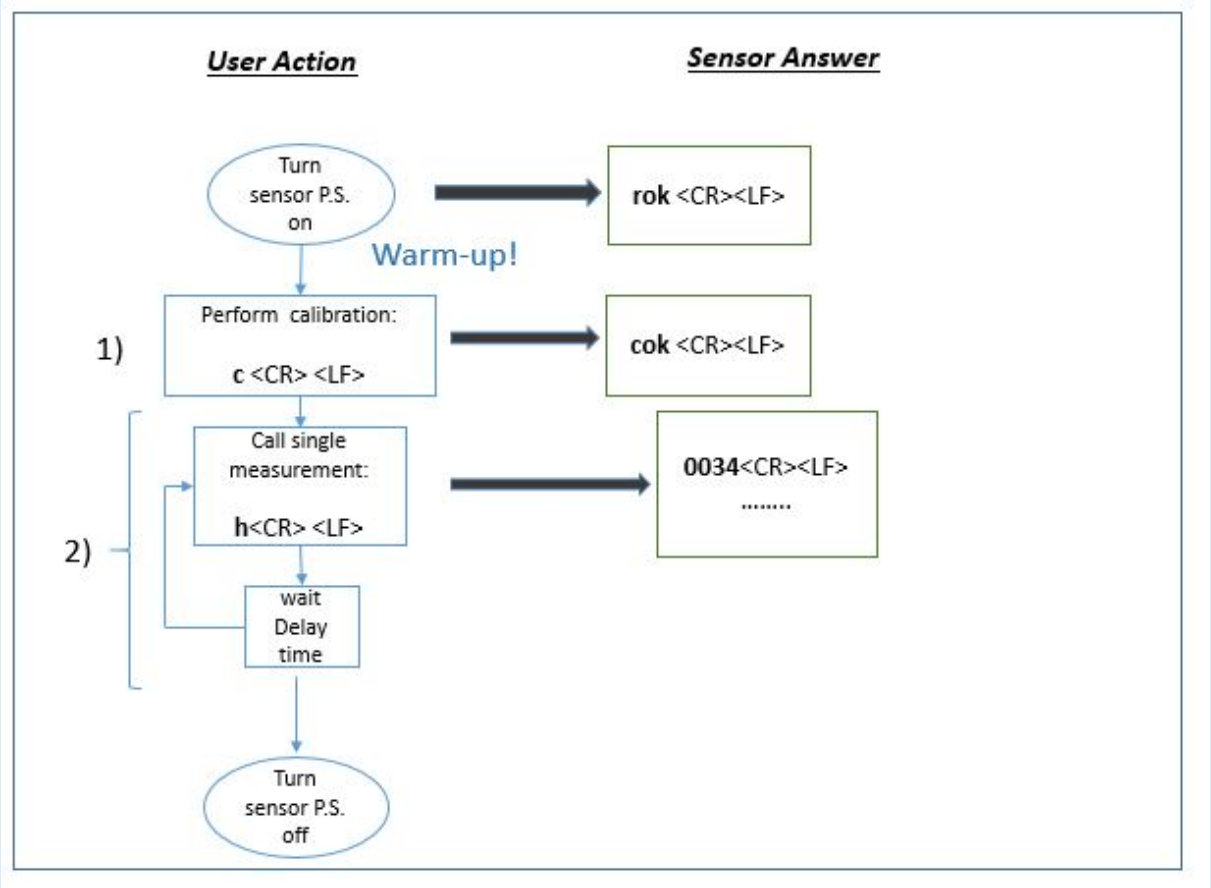
Step nr.1) is a zero level setting. It has to be accomplished in a clean environment in which no trace of the gas under detection can be present, preferably after 30 minutes of sensor warm-up. The gas under test is detected during the procedure nr.2) that can thus be performed in the measuring environment.



A command “d” can replace the command “c” if a faster calibration procedure is needed.

An alternative measuring mode is possible, in which the user can set the measuring intervals at his convenience. In the case the single measuring command is adopted, either “**l**” (fast response - low precision) or “h” (slow response - high precision) can be used, as detailed in the following flow-

chart. This procedure allows the user to choose the measuring time [fast (0.5 seconds) or precise (2 seconds)] and interval (by calling the single measure after a user-defined delay).

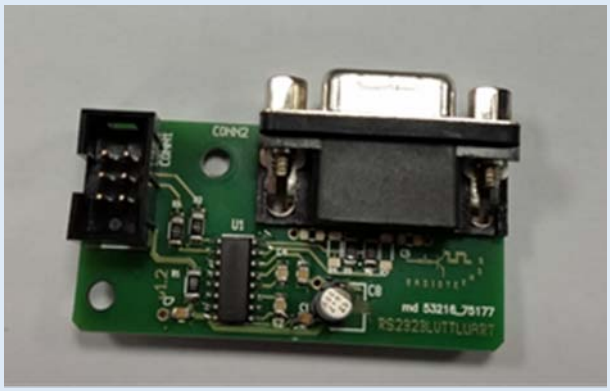


Again the procedure nr.1) must be performed in a clean environment, after a suitable sensor warm-up (preferably 30 minutes). When this is not possible, a saved calibration has to be used as explained previously.

Available connection boards

Some standard conversion boards are available, such as:

- UART – RS232 Conversion board
- UART – USB Conversion board
- UART – Bluetooth Conversion board



Other interface options available on request.