GPS-HS20

General

The GPS receiver GPS-HS20 processes signals from the GPS (Global Positioning System) and puts out the *3-D position* (latitude, longitude, altitude) and *speed over ground* at a rate of 50 ms. The GPS-HS20 corrects the raw GPS signals with information provided by EGNOS (European Geostationary Navigation Overlay System) to obtain Differential GPS signals.
The GPS-HS20 computes up to 20 independent measurements per cycle, with no interpolation or extrapolation from previous solutions. Position and velocity computations are performed simultaneously using all satellites in view. The GPS-HS20 uses instantaneous Doppler values from four satellites to compute dynamic speed, allowing velocity computations to be made independent of the last position fix.
At least 3 visible satellites are required to calculate a *2-D position* (latitude, longitude) and *speed over ground*. At least 4 visible satellites are required to calculate a *3-D position* (latitude, longitude, altitude).

Figure 1: GPS receiver GPS-HS20.

Figure 2: GPS antenna.

Technical Data

Number of channels:	14
Position and velocity output rate:	50 ms
Velocity accuracy:	0.1 m/s
Time to first fix:	3 s for re-acquisition 11 s for hot start 35 s for warm start 90 s for cold start
Power supply:	7 V to 15 V DC
Current consumption:	typical 170 mA at 12 V DC
Box size without plug, socket and cable:	115 × 70 × 28 mm

NMEA Settings

The GPS receiver GPS-HS20 is set up to transmit the two NMEA sentences *GGA* and *VTG* at a baud rate of 38400.
The sentence *GGA* contains the 3-D position and quality information (number of visible satellites, usage of DGPS), and the sentence *VTG* contains the speed over ground information.

Connectors

The GPS antenna must be connected to the *LNA* socket.

The *Power/NMEA* cable must be connected to the NMEA receiver (e.g. DL16CAN/SICO2).

The *PC RS232* plug is used for firmware upgrade and GPS receiver setup.

LED

Status: The *GPS status* is indicated by a red and a green LED. The number of green flashes after one red flash corresponds to the number of visible satellites.

Corr: The *differential corrections status* is indicated by a red and a green LED. The number of green flashes after one single red flash corresponds to the number of EGNOS corrections.

Scope of Supply

- GPS-receiver box GPS-HS20
- GPS antenna

Pin Assignment

The *Power/NMEA* cable has the following pin assignment:

Pin	Assignment	Description
1		
2	Ground	
3		
4	7…15 V DC	Power supply
5	TX	TX (for NMEA sentences)

The *PC RS232* plug has the following pin assignment:

Pin	Assignment	SUB-D-Plug of host PCs
1	TX	Pin 2
2	Ground	Pin 5
3	RX	Pin 3
4		
5		
		Pins 7 and 8 are bridged Pins 1, 4, 6 and 9 are bridged

SICO2GPS20

The signal converter SICO2GPS20 is a signal converter SICO2 with limited hardware features, but with a built-in GPS receiver GPS-HS20.
It can be used as stand-alone a GPS-receiver to provide NMEA sentences to a further acquisition system like SICO2 or DL16CAN (Power supply is then provided over the *RS232* connector).
It can also be used as a NMEA to CAN converter to broadcast the most recent *3-D position* and *speed over ground* information (beneath other signals) over the CAN (Power supply is then provided over the *PWR/CAN* connector).

Figure 3: Signal converter SICO2GPS20.

Connectors

The connector *RS232* is the same as the connector *Power/NMEA* of the GPS-HS20:

Pin	Assignment	Description
1		
2	Ground	
3		
4	7...15 V DC	Power supply
5	TX	TX (for NMEA sentences)

The connector *GPS PROG RS232* is the same as the connector*PC RS232* connector of the GPS-HS20:

Pin	Assignment	SUB-D-Plug of host PCs
1	TX	Pin 2
2	Ground	Pin 5
3	RX	Pin 3
4		
5		
		Pins 7 and 8 are bridged Pins 1, 4, 6 and 9 are bridged

The connector *PWR/CAN* is the same as the connector *PWR/CAN* of SICO2. The *On/Off* slider works only if SICO2GPS20 is powered via the *PWR/CAN* connector.

Pin	Assignment
1	Supplying voltage (7 V to 16 V DC inverse-polarity protected)
2	Ground
3	CAN_L
4	CAN_H

The connector *External Display* provides an output for the optional available external display ED1. Its pins are assigned as follows:

Pin	Assignment	Description
1	+12 V	Supplying voltage minus 1 V
2	Ground	
3	Analog Out1	Output voltage for LED bar
4	SDA	Serial data line
5	SCL	Serial clock line

Optional External Display ED1

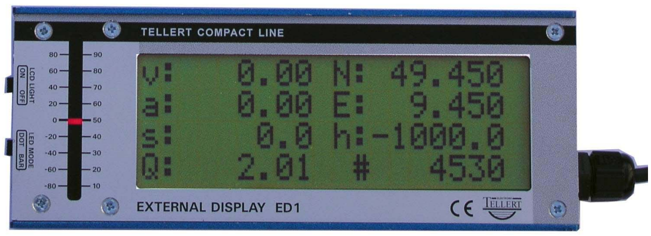

Figure 4: Optional external display ED1.

Motorbike Application

The GPS receiver unit is sensitive to vibrations. To avoid signal noise caused by vibrations, it is recommended to attach the GPS receiver unit at the driver and not at the vehicle.
The GPS antenna should be placed at the top-most point which is the crash helmet. The simplest way is to use an adhesive tape (without aluminium or other metal) to attach the antenna at the top of the helmet.

SICO2/DL16CAN Application

The GPS-HS20 can be directly connected to the signal converter SICO2 or data logger DL16CAN. The SICO2/DL16CAN provides the power supply for the GPS receiver and obtains the NMEA sentences via its 2nd serial port.
The principle setup within TEMES is the same as for GARMIN GPS-receivers, but with a baud rate of 38400 instead of 4800.
Beneath the 5 standard signals which are directly available within TEMES, the SICO2/DL16CAN firmware V3.05 (or better) supports further signals. However, the additional signals are not easily accessible within TEMES. The first step is to include a text block within the *device comment* of the TEMES parameter set. This text block commands the SICO2/DL16CAN to copy the additional GPS signal values to predefined signal addresses. The text block looks as follows:

```
<DPF>
[ExParameters]
ActionCode=44 a0 00 a2 01 a4 02  a6 03 a8 04
 aa 05 ac 06 ae 07 b0 08 ff
</DPF>
```

Note that the hex value sequence must not be line wrapped.
The signals are then accessible via TEMES constants with the corresponding fixed signal addresses. The signal address of a TEMES constant can be assigned by inserting a text block within the comment of the corresponding constant. It looks as follows:

```
[Parameters]
DeviceAddr=160
```

Where 160 is an example for the decimal signal address within the target device.

With the inclusion of the above mentioned *ActionCode*, the following TEMES constants must be defined:

Signal Address	Signal Description
160	GPS_v_kph: Speed over ground with a bit resolution of 0.01 kph
162	GPS_RMC_Counter: Counter for properly received and computed *RMC* sentences
164	GPS_GGA_Counter: Counter for properly received and computed GGA sentences
166	GPS_VTG_Counter: Counter for properly received and computed VTG sentences
168	GPS_GGA_Info: This compound information signal has a bit resolution of 0.01. The integer part represents the number of visible satellites, and the fractional part contains information about the GPS receiver mode as follows: 0.00: GPS receiver not ready 0.01: GPS fixes are valid 0.02: GPS receiver works in differential mode
170	GPS_LatLo: Least significant 16-bit word of the signed 32-bit latitude value
172	GPS_LatHi: Most significant 16-bit word of the signed 32-bit latitude value
174	GPS_LonLo: Least significant 16-bit word of the signed 32-bit longitude value
176	GPS_LonHi: Most significant 16-bit word of the signed 32-bit longitude value

Note 1: The signed 32-bit values for latitude and longitude have both a bit resolution of 1/60000 degrees.

Note 2: If the *ActionCode* mentioned above is included in the parameter set, it is obligatory to define the corresponding constants. Otherwise calculated signals or CAN input signals might be assigned to the predefined signal addresses and may therefore be corrupted by the *ActionCode*.

SIOC2/DL16CAN Example Files

The example parameter sets on the CD-ROM acquire the 5 standard and 9 additional GPS signals. This is realised with the settings for the serial input, with the device comment entry as mentioned above, and with the calculated signals F1 to F9.
The calculated signals F10 to F26 are used to compute the acceleration from the GPS speed signal (with a mean value filter over 0.4 s).
The calculated signals F27 to F33 are used to sum up the speed signal to obtain the distance. One distance value with a bit resolution of 10 cm, and another distance value with a bit resolution of 1 m.
The calculated signals F34 to F37 are used to reset the current distance value at a speed of above

100 kph (if the switch at the 2nd digital input is closed).
The calculated signals F38 to F41 are used to compute trigger signals for the CAN output. These both signals change to 1 if the corresponding NMEA sentence has just been received and computed. Otherwise these signals have the value 0. To use these signals as trigger output for the CAN, the corresponding entries in the device comment section are made (*CAN0FrameCond*...). Using a trigger for the CAN output allows to transmit only those messages over the CAN whose signals changed.
SICO2 and DL16CAN cannot use signals with a higher bit resolution of 16. But to provide the signed 32-bit value for latitude and longitude to other systems, the SICO2/DL16CAN can put out the least significant word and most significant word of the corresponding 32-bit value over the CAN. Other measurement systems can then obtain the 32-bit signal at once since the two 16-bit signals are properly overlaid with the bit position of the corresponding 32-bit signal.

DL16CAN Recording Application

It is recommended to use a recording sample rate of 10 ms to obtain a signal which is at least 3 times oversampled (and whose sample frequency is an integer multiple of 20 Hz). If both data logger and NMEA receiver are synchronized to each other, each recorded sample value is repeated three times (or more). But due to quartz deviation and interrupt latencies, the NMEA sentences are received with a small jitter and arrive occasionally just before or just after a new DL16CAN sample. This jitter can be removed with an offline calculation of the oversampled signals. This offline calculation aligns the sample values to the 20 Hz grid and replaces the repeated (oversampled) values with linear interpolated ones.
A corresponding TEMES offline calculation definition file might look as follows:

```
[Rules]
Include=t,v_f,s_f,_a_f,a_f
DefCount=4
Def0=v_f,gpsv,GPS_v_kph,GPS_v_kph,0.05,100,0.2
Def1=s_f,sumt,v_f,0.00027777777777778,km,0.00001
Def2=_a_f,derive,v_f,0.2777777777777778,m/s²
Def3=a_f,firlp,_a_f,127,-0.4,BLACKMAN-
  HARRIS,AUTO
```

Note that the *Def3* entry must not be line wrapped. The *Include* entry lists all signals which are added to the measurement as a new measurement block (The time signal *t* must always be included as first signal of a measurement block). The *DefCount* entry contains the number of following signal definitions. *Def0* defines the signal *v_f* as a 0.05 s grid aligned version of signal *GPS_v_kph* and with spikes being removed (spikes are here detected if the first time derivative exceeds 100 kph/s with a maximal spike width of 0.2 s). *Def1* integrates the speed signal to obtain the distance with a signal resolution of 1 cm. *Def2* derives the speed signal to get the acceleration. And *Def3* smoothes the acceleration signal by using a 127th order low pass FIR filter with a cut-off frequency of 0.4 Hz and a Blackman-Harris window.