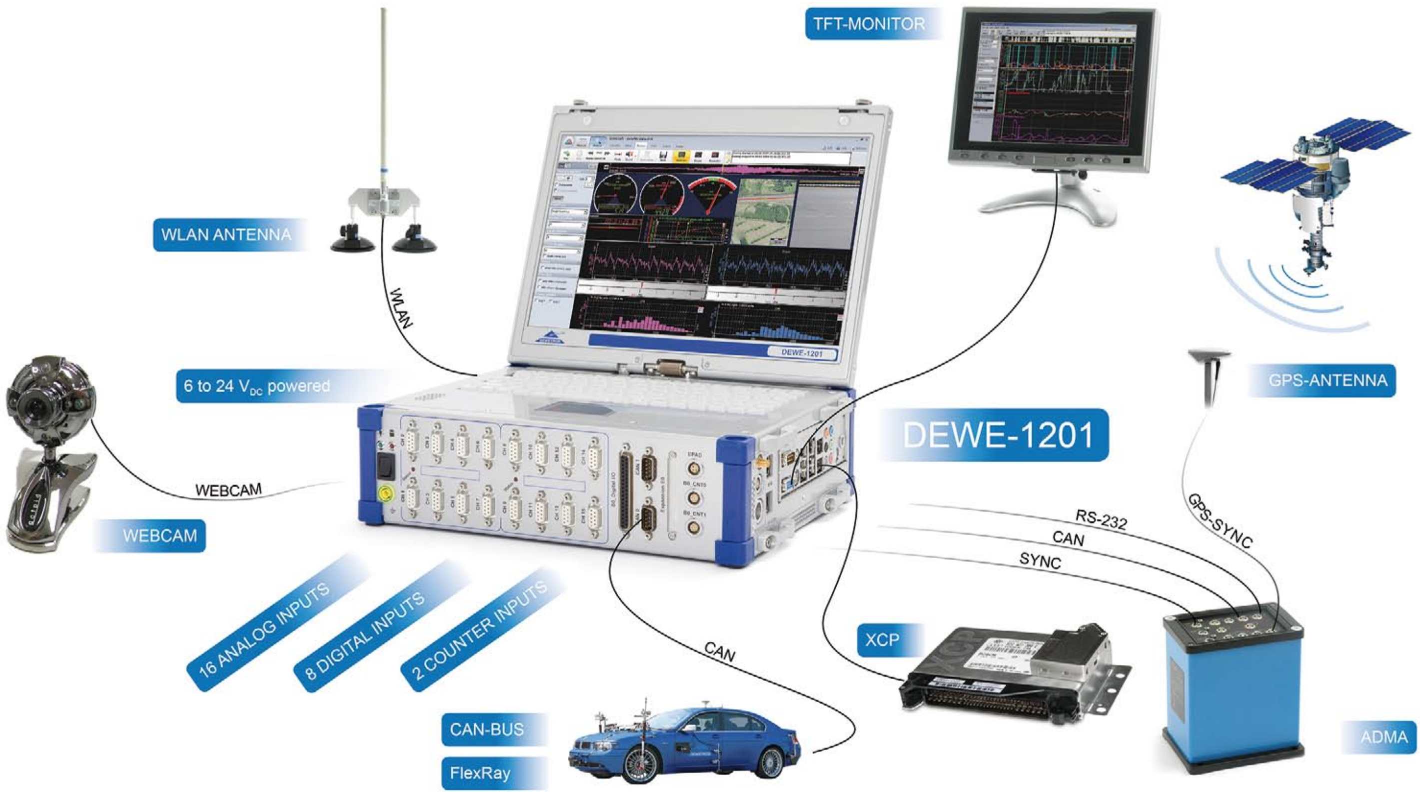


CAPS (Combined Active Passive Safety) Instruments

DEWE-CAPS ... to test driver assistance systems

The DEWETRON CAPS series instruments are made for any dynamic test of vehicles where precise position information is required. All dynamic movements such as acceleration, speed, position, turning speed and angle of the vehicle are measured synchronously to analog sensors, counters, CAN bus and video data.

There are a lot of applications such as ADAS (Advanced Driver Assistance System) testing, LDW (Lane Departure Warning), functional safety testing, etc. where very accurate position information (down to 2 cm possible!) is needed.

One typical application is to test longitudinal control systems such as ACC (Adaptive Cruise Control). These measurements are usually performed with two or more vehicles. Each vehicle is equipped with a DEWETRON CAPS instrument and a GeneSys ADMA GPS/INS system. The communication link between each vehicle is WLAN. The DEWETRON data acquisition unit synchronously records the CAN data from the ADMA GPS/INS system and vehicles, together with data from optional digital and analog sensors and video images of the driver.

The key parameters for testing longitudinal control systems such as ACC include the relative position, the relative velocity and the relative heading between the leading car and the hunting car. (The ACC system to be analyzed is in operation in the hunting car.) There are also further parameters that are relevant, such as acceleration, velocity, 3D track data, corner radius and the precise time reference. Captured video data should simultaneously be available to check the driver status as well as the environmental conditions. Perfect synchronization of data is essential to reach the required accuracies for relative position.

Key Features

- *Precise position, angle, distance, speed and heading information is recorded fully synchronized together with analog, counter, CAN bus and video data*
- *High accurate combined GPS and Gyro measurement*
  - *INS/GPS system from GeneSys for six degree of freedom motion analysis*
  - *High performance differential GPS position measurement*
- *GPS synchronized measurements from 2 vehicles with online data transfer*
- *Easy mounting, setup, alignment and calibration*
- *Comparable and reproducible tests*
- *Automated report generation for predefined maneuvers*
- *Safe investment, all systems can grow with future applications*

DEWETRON CAPS instruments are a safe investment! Due to their modularity they can grow with future applications.

CAPS Instruments

Nothing is required to complete these instruments

	DEWE-211-CAPS-16	DEWE-501-CAPS-32	DEWE-510-CAPS-16
Analog input channels	16	32	16
Supported analog input signals	Voltage ±10 V or strain gauge input via two MDAQ-SUB-STG; by optional MSI also IEPE, voltage ±200 V, thermocouple, RTD and charge	Voltage ±10 V or strain gauge input via two MDAQ-SUB-STG; by optional MSI also IEPE, voltage ±200 V, thermocouple, RTD and charge	Any analog signal via appropriate DAQP module
External quasi-static channel expansion	EPAD interface, up to 16 EPAD2 modules = 128 ch		
A/D conversion			
Sampling method	Simultaneous sampling		
Sampling rate	100 kS/s per channel		
Resolution	16 bit		
Digital I/O and counters			
Digital I/O	8, TTL level		
Counters / digital inputs	2 counters or 8 digital inputs, TTL level		
CAN bus			
High-speed CAN bus interfaces	2	4	4
Video input option			
UP-DEWE-CAM-01 adds synchronized video picture acquisition of up to 200 FPS (frames per second) up to 70 fps at 640 x 480 pixel up to 200 fps at 640 x 120 pixel	✓	✓	✓
Data storage [1]			
Technology	Solid State Disk	Solid State Disk	Solid State Disk
Capacity	32 GB	64 GB	64 GB
Max. gap free storing to disk	Typ. 40 MB/s	Typ. 40 MB/s	Typ. 40 MB/s
Typ. duration of recording (16 ch. / 10 kS/s/ch. / 16 bit)	1 days	2 days	2 days
Main system [1]			
Display	External display MOB-DISP-12A	External display MOB-DISP-12A	External display MOB-DISP-12A
Processor	Intel® Core™2 Duo 2 GHz	Intel® Core™2 Duo 2 GHz	Intel® Core™2 Duo 2 GHz
WLAN set with professional external antenna and mounting kit, cable set for connection to GeneSys ADMA platform	✓	✓	✓
Power supply			
Standard	8 to 30 V_{DC}, incl. external AC power supply (Optional battery pack for ~2 hrs.)	Battery powered, 2 battery slots[2], 2 batt. for ~2 hrs. operation incl., incl. external AC power supply and external DCDC converter for 9 .. 36 V_{DC} input	Battery powered, 3 battery slots[2], 2 batt. for ~2 hrs. operation incl., incl. external AC power supply and external DCDC converter for 9 .. 36 V_{DC} input
Dimensions			
Dimensions (W x D x H)	317 x 252 x 92 mm (12.4 x 9.9 x 3.6 in.)	439 x 209 x 181 mm (17.2 x 8.2 x 7.1 in.)	439 x 308 x 181 mm (17.2 x 12.1 x 7.1 in.)
Weight without batteries	Typ. 5 kg (11 lb.)	Typ. 6 kg (13.2 lb.)	Typ. 8 kg (17.6 lb.)
Required sensors			
Additionally required sensors	GeneSys ADMA INS/Gyro system		

[1] Please find current specifications in the latest price list

[2] Weight of one battery: 660 g (1.45 lb.)

GeneSys ADMA INS/Gyro system

Description

The ADMA gyro system was especially developed for dynamic testing of vehicles. The ADMA-G continuously measures both the acceleration and position in all three axes and the pitch, roll and heading angle of a moving vehicle. The system can also be used for the dynamic calculation of speed. The ADMA-G is the sophisticated ADMA version with an integrated GPS receiver for highly accurate measurements.

The system comprises:

- *three fibre-optic gyros (unaffected by acceleration) for detecting rotational motion;*
- *three servo accelerometers for determining acceleration;*
- *an internal GPS receiver for accurate position update with WAAS- or RTK-DGPS corrections;*
- *a 32-bit processor unit that continuously calculates the angular orientation and position from internal sensor signals and*
- *external information (e.g. velocity sensors).*

The package is implemented in strap-down-technology without moving parts and is therefore extremely robust and resistant to shock and vibration. Additionally, all components for DGPS data generation (antennas, radio link ...) are provided.

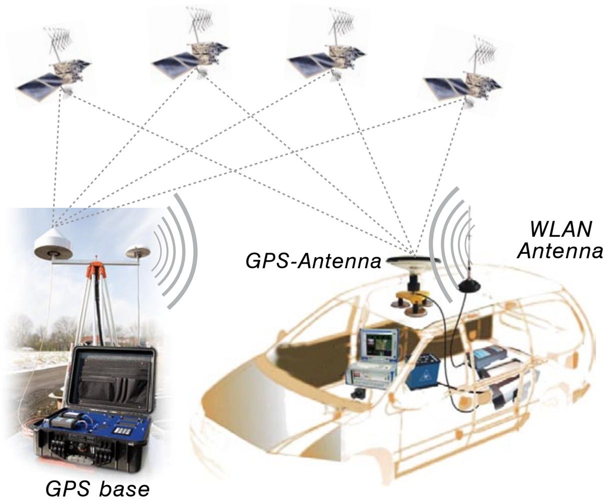
The calculation algorithms are optimised for dynamic vehicle tests such as slalom and circular movement and take account of the gravitational acceleration and rotation of the earth. In addition to the integrated DGPS receiver, an external speed signal (odometer or Correvit) can be connected in order to improve the accuracy of positional data and heading angle stability. The extended Kalman filter merges the internal with the external sensor data to achieve high-frequency output as well as great accuracy. In this way, positional accuracy in the centimetre range can be obtained while the vehicle is in motion.

Technical Data		
Gyros	Quantity / Type	3 closed-loop fibre optic gyros
	Measuring range heading / roll / pitch	± 320 °/s
	Resolution heading / roll / pitch: 0.00004 °/s	0.00004 °/s
	Bias variation over temperature	range better than 6 °/h, optional 1 °/h
	Bias instability	typically 0.2 °/h
	Gyro noise	better than 0.6 °/Öh, typ. 0.2 °/Öh
	Scale factor accuracy	better than 0.1 %, typ. 0.06 %
Accelerometers	Quantity / type: 3 servo accelerometers	Quantity / type: 3 servo accelerometers
	Measuring range: ± 5 g	Measuring range: ± 5 g
	Measuring accuracy better than 1 mg	Measuring accuracy better than 1 mg
	Measuring resolution: 300 µg	Measuring resolution: 300 µg
GPS	Measuring accuracy	0.01 / 0.2 / 0.45 / 0.8 / 1.2 / 1.5 / 1.8 m (GPS receiver dependent)
	Measuring precision	0.075 / 0.2 / 6 / 25 cm (GPS receiver dependent)
	Data update rate	up to 50 msec (internally interpolated from 20 to 2.5 msec)
	WAAS/EGNOS-DGPS corrections or RT2-DGPS corrections (via radio link)	
Complete system	Angle measuring range heading / roll / pitch	± 180 / 60 / 60 °
	Angle measuring accuracy static / dynamic	better than 0.05 ° / typical 0.1 °
	Angle resolution	0.005 °
	Measuring axis misalignment	< 1 mrad
	Initial alignment	with internal GPS receiver or by manual input
	Interface	RS 232, 115200 baud or CAN
	Data update rate	50 - 400 Hz
	Sync input and output	TTL, optically isolated
	Event input (e.g. for lap index)	TTL, optically isolated
	Input	for GPS antenna and radio link for DGPS corrections
	Speed input	2 x (Vx, Vy), analog 14 bit or TTL pulse
	Interface	for internal software upgrade
	Power supply	selectable 12 / 24 / 48 VDC, ± 10 %, 15 Watt
	Dimensions (W x L x H)	110 x 170 x 180 mm
	Weight	3.0 kg
	Temperature range	-20 to +60 °C

Measurement Setup of an ACC system

Both vehicles are equipped with a DEWETRON CAPS instrument and an ADMA GPS/INS system. Within the CAPS instrument, a precise 80 MHz system clock is generated and synchronized to the atomic clock reference signal of the GPS satellite (PPS). Dividing the system clock to multiple-phase synchronous slower clocks for analogue inputs, CAN data or video pictures ensures that all recorded data are in perfect sync.

The GPS PPS synchronization technology is also available in the ADMA system, allowing for the measurement of any ADMA running synchronized with the GPS PPS signal. Additionally, all ADMA data are time-tagged. As the synchronization to GPS works independently in two or more cars and all data is synchronized, the data transfer between the cars can be achieved via an asynchronous WLAN. Through the use of special WLAN antennae, the distance between the two cars can range up to 400 m at a speed of 200 km/h (124 mph). Online, the DEWETRON CAPS system calculates the relative position and velocity information. The driver is able to see live measurement data displayed on a windshield-mounted screen to ensure repeatable driving manoeuvres.



Measurement setup of ACC (Adaptive Cruise Control) testing

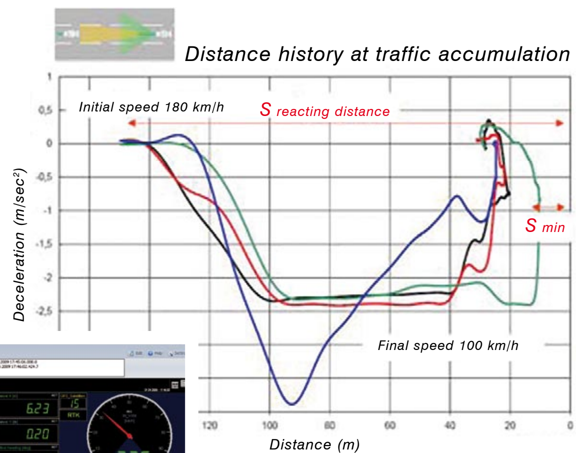
Zero latency between the measurement data leads to significantly less uncertainty of the measurement results and dramatically reduces the effort of data preparation – time savings of up to 50 % are possible simply by eliminating the need for post-correlation and correction.

*Perfect synchronization of data is essential to reach the required accuracies for relative position. Considering a speed of 100 km/h (62 mph) and the relative position accuracy requirement of 5 cm, the time delay of data from car one and car two must not exceed 2ms during the complete test. Or, in other words, a time delay of 40 ms at a speed of 100 km/h results in an error of more than 1m. (V = 100 km/h = 27.8 m/sec → 27.8 m/sec * 0.04 s = 1.11 m error.)*

Typical report

The figure shows one exemplary graph where the maximum deceleration rate of different cars was evaluated while convoy approaching. The ACC had to adapt the initial speed of 180 km/h (112 mph) to a final speed of 100 km/h (62 mph). It can be seen quite clearly that the 'green car' reaches a critical minimum distance of approximately only 6 m to the convoy. The reaction was slow and the braking process was induced late. It can also be observed that the 'blue car' reacted slowly but one avoided a critical distance by decelerating hard – more than 3.5 m/sec², which significantly reduces the level of comfort for the occupants.

Distance history at traffic accumulation



The results of already evaluated ACC vehicles are available in an online database, data that can save significant efforts measuring benchmark vehicles.