



## Whitepaper

### Glasgow ECG Analysis Algorithm

Version 1.1

### Disclaimer

This white paper explains the basic function of ECG analysis with the Glasgow algorithm.

It is based on the user's introduction to the device and knowledge of the user manual.

The use of an automated ECG analysis does not replace the ECG interpretation skills of the user.

### Upgrade to the Glasgow ECG Analysis Algorithm

From version 4.1 of the **corpus3** software, the ECG analysis is changed from HES® to the Glasgow algorithm.

The database was created in 1964 at the University of Glasgow and has been continuously developed since then. This ECG database contains a large number of ECG data from all age groups. This allows an improved ECG interpretation adapted to the age of the patient.



## Glasgow versions

The analysis by the Glasgow algorithm is available on the **corpus3** in two different versions:

Glasgow Basic	Glasgow Full Scale
<p>Measurement table with</p> <ul style="list-style-type: none"><li>• P duration</li><li>• PR interval</li><li>• QRS duration/time</li><li>• QT interval</li><li>• ST segment measurement in standard Einthoven, Goldberger and Wilson leads</li></ul>	<p>Alarms with short ECG interpretation Additionally:</p> <ul style="list-style-type: none"><li>• Advanced measurement table for all leads</li><li>• Supplementary parameters</li></ul>

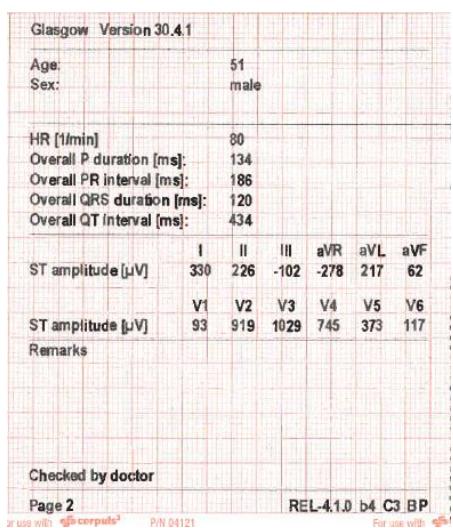


Fig. 1: ECG printout using Glasgow Basic

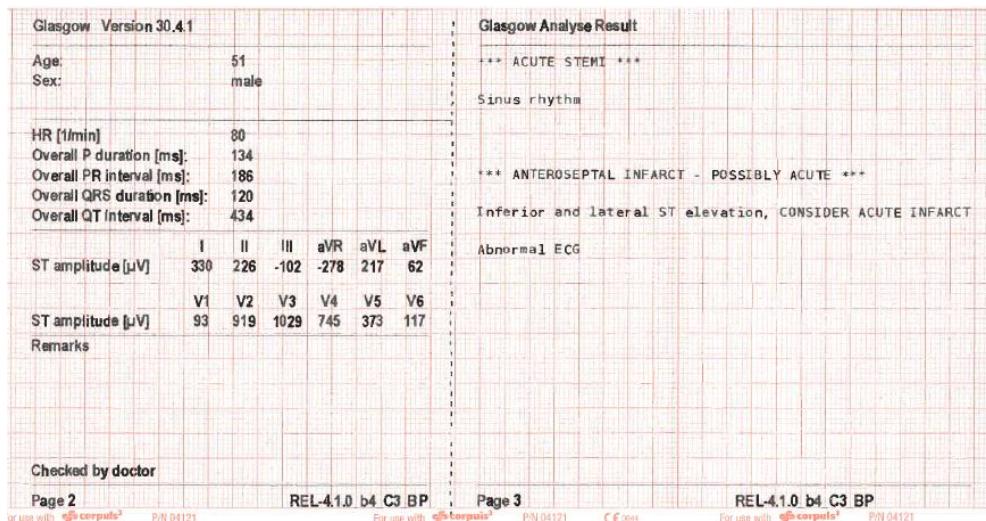


Fig. 2: ECG printout using Glasgow Full Scale (ECG interpretation)

Glasgow Measurement Table													Glasgow MeasurementTable		
	I	II	III	aVR	aVL	aVF	V1	V2	V3	V4	V5	V6	Heart rate Variability		
Q duration [ms]	0	23	25	0	0	25	102	80	66	38	26	24	LHV Score	36	
Q amplitude [µV]	0	-56	-61	0	0	-57	-1152	-1204	-308	-110	-62	-45	Overall P duration [ms]	186	
R duration [ms]	90	92	51	19	21	92	0	0	0	0	89	93	Overall QRS duration [ms]	112	
R amplitude [µV]	411	723	405	32	33	561	0	0	0	0	742	835	Overall ST duration [ms]	120	
S duration [ms]	0	0	40	92	34	0	0	0	0	0	0	0	Overall T duration [ms]	100	
S amplitude [µV]	0	0	-123	-531	-89	0	0	0	0	0	0	0	S amplitude in V1 (max Q,S,S',S'') [µV]	216	
ST amplitude [µV]	342	244	-99	-293	221	73	104	953	1057	768	389	135	R amplitude in V5 (max Q,S,S',S'') [µV]	1152	
T+ amplitude [µV]	400	360	116	0	236	264	488	1545	1297	937	463	128	SV1+RVS [µV]	742	
T- amplitude [µV]	0	0	-87	-365	0	0	0	0	0	0	0	0	Overall PR interval [ms]	1894	
P area [µVms/20]	-8	-269	-265	136	131	-267	-293	-703	-511	-420	-236	-141	204		
P morphology	1	1	1	-1	1	1	2	1	1	1	1	1	Heart rate Variability		
T morphology	1	1	-2	+1	1	1	1	1	1	1	1	1	LHV Score		
Delta Wave confidence [%]	0	0	0	0	0	0	0	0	0	0	0	0	Overall P duration [ms]		
QT interval [ms]	408	434	390	430	432	436	418	410	428	436	434	366	Overall QRS duration [ms]		
ST-T Mid-point amplitude[µV]	332	231	-101	-281	216	65	162	1021	1051	763	378	114	Overall ST duration [ms]		
ST80 amplitude [µV]	342	242	-100	-291	221	71	209	1098	1082	787	382	103	Overall T duration [ms]		

**Seite 7** REL-4.1.0 b3\_C3\_BP **Seite 8** REL-4.1.0 b3\_C3\_BP  
For use with corpus<sup>®</sup> P/N 04121 For use with corpus<sup>®</sup> P/N 04121 C € 0.00 For use with corpus<sup>®</sup> P/N 04121 For use with corpus<sup>®</sup> P/N 04121 C € 0.00

Fig. 3: ECG printout using Glasgow Full Scale (measurement table)



## Software version and effects

The following overview shows the available software versions of the **corpus3** and the options of the ECG analysis:

	Software before 4.1.1	Software 4.1.1	Software 4.1.2	Software 4.2.x	
Standard-configuration	HES light	Glasgow Basic	HES light	Glasgow Basic	
Optional	HES pro mit corpus S / ACS	Glasgow Full Scale	HES pro mit corpus S / ACS	HES pro mit corpus S / ACS	Glasgow Full Scale

The licences for ECG analysis are available under the following article numbers:

04208 HES pro                                  S04209 Upgrade Glasgow Full Scale  
04209 Glasgow Full Scale                        S04209.2 Upgrade from HES pro to GlasgowFull Scale

## Interaction of corpus3 and the Glasgow algorithm

The Glasgow algorithm is an application installed on the **corpus3** which is used for interpretation of D-ECG data.

The ECG is recorded by the **corpus3**, the data are processed by the Glasgow algorithm and different messages can be displayed/printed by the **corpus3**.

## Possible ECG diagnosis by the Glasgow algorithm

The Glasgow ECG analysis algorithm can recognize a wide range of ECG findings. These findings can be printed out as an ECG interpretation with the Glasgow Full Scale version. These are some examples:

- Frequency (defined limits for bradycardia and tachycardia)
- Various signs of myocardial infarction:
  - STEMI
  - Sgarbossa criteria
  - ST abnormalities
  - ST-T abnormalities
- PR/QT interval
- Atrial abnormalities
- QRS axis deviation
- Conduction defects like bundle branch blocks
- WPW and Brugada patterns
- Hypertrophy patterns



## Critical values of ECG analysis

Complementary to ECG diagnosis the Glasgow ECG analysis identifies seven critical values. These values prompt an alarm to be displayed on the **corpus3**.

The alarm messages are generated from different ECG findings during analysis and are only available with Glasgow Full Scale. Additionally, the alarm message appears on the ECG printout.

The following alarm messages can be generated by the Glasgow algorithm and displayed and printed by the **corpus3**:

Alarm message	ECG findings/diagnosis
*** ACUTE STEMI *** <sup>1</sup>	++ ST elevation or CONSIDER ACUTE INFARCT or POSSIBLE ACUTE ++ INFARCT or ++ INFARCT – POSSIBLY ACUTE
*** POSSIBLE ACUTE STEMI *** <sup>1</sup>	++ ST elevation or CONSIDER ACUTE INFARCT or POSSIBLE ACUTE ++ INFARCT or ++ INFARCT – POSSIBLY ACUTE
*** ACUTE MI / ISCHEMIA ***	Marked ++ ST depression or CONSIDER ACUTE INFARCT or CONSIDER ACUTE INFARCT (proximal LAD occlusion) or CONSIDER ACUTE INFARCT (left main occlusion/multivessel disease) or Widespread ST depression
*** EXTREME TACHYCARDIA ***	Alarm limits adapted to the patient age: <ul style="list-style-type: none"><li>• 0 to 28 days: 213 -&gt; 230/min</li><li>• 29 to 180 days: 230/min</li><li>• 181 days to 17 years: 230 -&gt; 150/min</li><li>• 18 years and older: 150/min</li></ul>
*** EXTREME BRADYCARDIA ***	Alarm limits adapted to the patient age: <ul style="list-style-type: none"><li>• 0 to 28 days: 73 -&gt; 90/min</li><li>• 29 to 365 days: 90/min</li><li>• 1 to 6 years: 90 -&gt; 45/min</li><li>• 6 to 12.5 years: 45 -&gt; 40/min</li><li>• &gt;12.5 years: 40/min</li></ul>



Alarm message	ECG findings/diagnosis
*** SIGNIFICANT ARRHYTHMIA ***	<ul style="list-style-type: none"><li>• Supraventricular tachycardia</li><li>• Probable supraventricular tachycardia</li><li>• Probable ventricular tachycardia</li><li>• Consider ventricular flutter/fibrillation</li><li>• Accelerated idioventricular rhythm</li><li>• Possible idioventricular rhythm</li><li>• Wide QRS tachycardia - possible supraventricular tachycardia</li><li>• Wide QRS tachycardia - possible ventricular tachycardia</li><li>• A-V dissociation with<ul style="list-style-type: none"><li>◦ paroxysmal idioventricular rhythm</li><li>◦ multifocal interpolated PVCs</li><li>◦ frequent multifocal PVCs</li><li>◦ non-sustained ventricular tachycardia</li><li>◦ 2nd degree A-V block, Mobitz I (Wenckebach)</li><li>◦ 2nd degree A-V block, Mobitz II</li><li>◦ complete A-V block</li></ul></li></ul>
*** PROLONGED QTc INTERVALL ***	HF above 125/min AND QRS interval < 120 ms AND QTc interval > 520 ms

Comments regarding alarm messages:

++: The location of the infarction (e.g., anterior, inferior, anteroseptal) is added in the original message text

<sup>1</sup> The value limit of the ST elevation ist calculated by the algorithm based on the sex and age of the patient.

Two different parameter limits lead to different alarm messages:

- Exceedance of the *higher* limit: Acute STEMI
- Exceedance of the *upper* limit, but below the *higher* limit: *Possible* acute STEMI

The entry of age and sex of the patient at the beginning of the D-ECG interpretation is crucial for a correct diagnosis.

## List of references

Translations of the messages of the Glasgow algorithm.

GS Elektromedizinische Geräte G. Stemple GmbH (2021): *Glasgow 12-lead ECG Analysis Program*, Version 1.0. Kaufering.