FS-AI Remote Emergency Stop (RES)

The main Formula Student rules (DV 1.4) delegate the specification of the Remote Emergency Stop / System to the 'competition handbook'.

For the IMechE Formula Student FS-AI event this document represents the 'competition handbook' and may be used by participating teams to prepare their entries to the competition.

The RES specifications have been adapted from 'FSG21_Competition_Handbook_v1.0.pdf' downloaded from:
https://www.formulastudent.de/fileadmin/user_upload/all/2021/rules/FSG21_Competition_Handbook_v1.0.pdf

NOTE: for the IMechE Formula Student FS-AI competition this document takes precedent.

Should the FSG competition handbooks be updated, any changes MIGHT NOT be carried over for IMechE Formula Student FS-AI. Any changes will be discussed with participating teams before adoption. This is to ensure the full competition specification and rules set is available at the beginning of the competition year. See Table 1 below:

Table 1:

IMechE Formula Student FS-AI Competition Year	FSG Handbook used for Specification
2021 (begins Sept 2020)	'FSG21_Competition_Handbook_v1.0.pdf'
2022 (begins Sept 2021)	'FSG21_Competition_Handbook_v1.0.pdf'

Where applicable, paragraph headings have been adopted from the FSG Competition Handbook. Deletions from the original text are marked in ~~Red~~. Additions are marked in **bold**.

DE7.4 [DV ONLY] Remote Emergency System (RES)

DE7.4.1 The RES that has to be used for the competition is a GF2000i-codec / T53R98 combination from Gross-Funk GmbH[11].

- SIL3 (EN61508) certified
- EMV certified
- communication in 430MHz to 440MHz band
- increased signal strength of 88mW
- 12V to 24V supply voltage (0:26A @12 V)
- 450 g, 173mm x 113mm x 35mm
- IP20 (receiver) / IP65 (sender)

RES sender & receiver

[11] https://f.fs-g.org/2017/important_docs/FSG2017_Gross-Funk_v20170126.pdf

DE7.4.2 Please contact Mr. Keller (christian.keller@grossfunk.de) at Gross-Funk for purchasing.

~~DE7.4.3 Regarding the increased signal strength, the BNetzA registration for Hockenheim will be provided by the officials.~~

DE7.4.4 The receiver includes a normally-open (NO) relay which must be part of shutdown circuit. It opens on switching shutdown, on signal loss, and on power loss. Maximum current rating is 4 A.

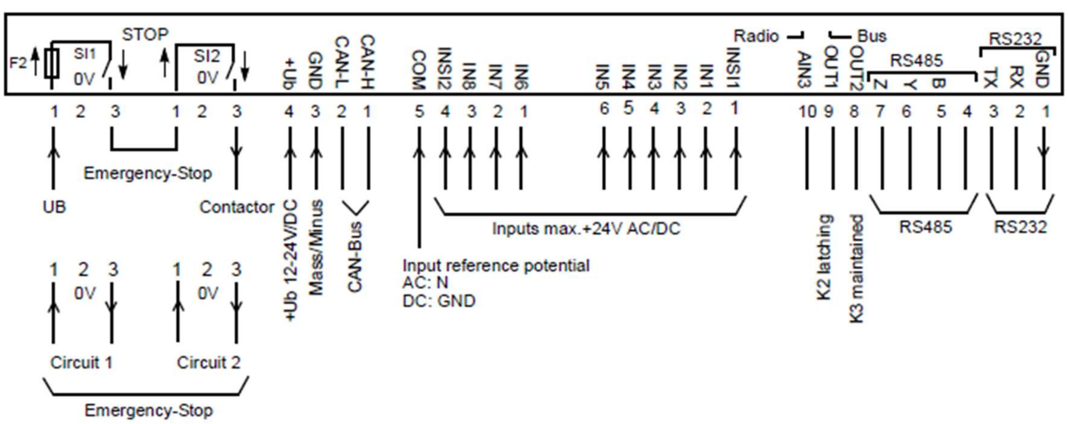

Figure 8: Connections at the RES receiver

DE7.4.5 The CANopen interface of the receiver has the following properties:

- 1000 kbit/s, 125 kbit/s, 250 kbit/s and 500 kbit/s in standard configuration.
- Cyclic PDOs containing states of switches (Go-signal) and radio
- Warns if signal loss detected (200 ms in advance to shutdown, contained in cyclic PDO)

DE7.4.6 The Node-ID and baud rate settings of the vehicle-side installed receiver can be configured with the external DIP switch:

DIP SW	1	2	3	4	5	6	7	8	Baud Rate
Node-ID	+1	+2	+4	+8	+16	+32	0	0	1 Mbit/s
Bit	0	1	2	3	4	5	1	0	125 kbit/s
							0	1	250 kbit/s
							1	1	500 kbit/s
	Node-ID						Baud Rate		

Table 10: DIP switch configuration RES.

DE7.4.7 The Node-ID has to be set to 0x011 at the competition. Only in severe cases, there will be an exception. Please give a detail problem description with the request.

DE7.4.8 The receiver is booted up and sends a message to signalize its initialization (NMT message with CAN-ID 0x700 + Node-ID and a single data byte 0x00). A CAN/CANopen master device must set the receiver to operational mode (NMT message CAN-ID = 0x000, byte 1 = 0x01 (requested state), byte 2 = addressed Node-ID or 0x00 for all). After setting to operational mode, the receiver starts sending a status message of 8 bytes containing PDOs 2000 - 2007 (one byte each, CAN-ID = 0x180 + Node-ID) every 30 ms.

DE7.4.9 Manually resetting the RES before sending the operational mode message may be used to check if the device is online (NMT message CAN-ID = 0x000, byte 1 = 0x80 (requested state), byte 2 = addressed Node-ID). This will be answered with the boot-up message.

DE7.4.10 Beside the CAN-IDs mentioned in DE7.4.8 and DE7.4.9, be aware not to use the CANopen-related IDs listed in Table 11 on the bus[12].

Communication object	CAN-ID	Slave nodes
NMT node control	0x000	Receive only
Sync	0x080	Receive only
Emergency	0x080 + Node-ID	Transmit
TimeStamp	0x100	Receive only
PDO	0x180 + Node-ID	1. Transmit PDO
	0x200 + Node-ID	1. Receive PDO
SDO	0x580 + Node-ID	Transmit
	0x600 + Node-ID	Receive
NMT node monitoring	0x700 + Node-ID	Transmit
LSS	0x7E4	Transmit
	0x7E5	Receive

Table 11: Reserved message IDs for RES.

[12]https://www.can-cia.org/fileadmin/resources/documents/brochures/co_poster.pdf

DE7.4.11 System misbehaviour and faulty logs caused by misuse of these messages eliminates the demand for a re-run and may lead to a Disqualified (DQ). Same counts for any kind of hardware manipulation to the sender and receiver or improper antennas modifications. In doubt, the logs available on the official DL (see Section DE7.3) count.

DE7.4.12 The status of the switch (K2) and the button (K3) at the sender is contained in the PDO 2000 (bit 1 and 2) as well as on the digital outputs. The E-Stop is signalized by PDO 2000 bit 0 and PDO 2003 bit 7. PDO 2006 contains the radio quality (0% to 100%) whereas PDO 2007 summarizes several radio states, i.e. the pre-alarm radio communication interruption (bit 6, 200 ms in advance to shutdown).

DE7.4.13 Either K2 or K3 are allowed to be used to signalize the Go-signal for switching from "Ready" to "Driving" state, see DV2.4, Figure 21. Both the CAN message or the digital outs can be used.