



IFS boxes and flanges: status and strategy

- Introduction
- HL-LHC flanges
- HL-LHC IFS boxes
- Production status
- Conclusion



G. D'Angelo, with inputs from WP3

12th HL-LHC Collaboration Meeting, Uppsala, 19-22 September 2022

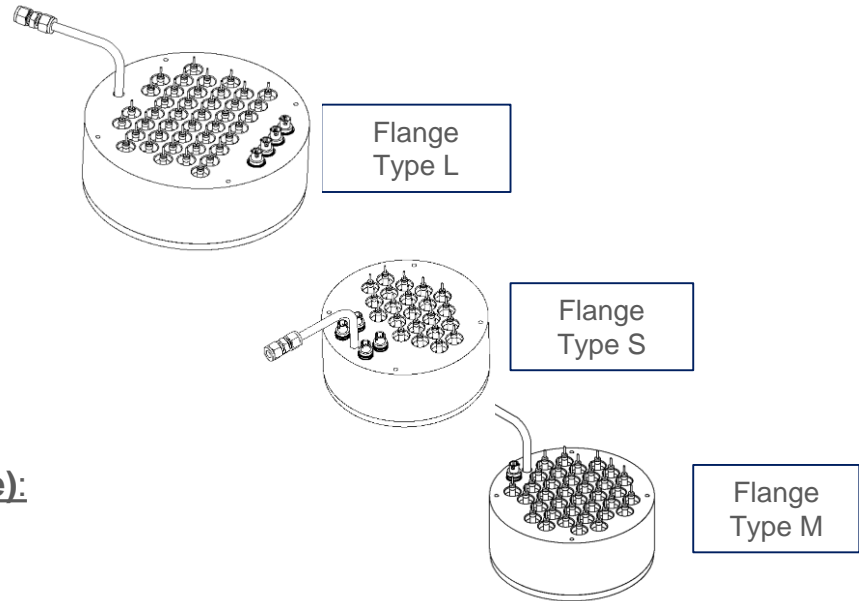
Introduction

- In order to route HL-LHC magnet (or other components) instrumentation needed for protection and monitoring of HL-LHC circuits, dedicated HL-LHC Instrumentation Feedthrough System (I.F.S.) boxes installed on the cold-mass assemblies have been designed.
- Following the HL-LHC instrumentation review (sep.2020), and after a final optimization of cover flange types, 3 types of flanges are present for HL-LHC components: type L, M and S.
- HL-LHC I.F.S. boxes and flanges have been integrate also in DFX and DFM components and will be used by WP3.
- The integration of the flanges and the I.F.S. boxes was performed carefully with integration team.
- Prototype IFS boxes have been produced, tested and are being used on HL-LHC cold masses (at CERN and AUP).

HL-LHC Flange types

Final configuration of flange type approved:

- Cover Flange Type L:
 - Diameter: 260 mm
 - **42** HV Feedthroughs
 - 4 x LV Feedthroughs (4 pins)
- Cover Flange Type S:
 - Diameter: 208 mm
 - **22** HV Feedthroughs
 - 4 x LV Feedthroughs (4 pins)
- Cover Flange Type M (similar to LHC type):
 - Diameter: 208 mm
 - **36** HV Feedthroughs
 - 1 x LV Feedthroughs (4 pins)



However, 6 prototypes flanges “Type L” of 48 HVs were produced and are used in the first Q1/Q3 magnets. Two prototypes flanges “Type S” of 18 HVs were also produced and will be used on first Q2 magnets. The IFS boxes are adapted accordingly.

HL-LHC I.F.S. boxes type

Based on the 3 type of flanges, 14 different type of IFS boxes are needed in order to cope the diversity of instrumentation present in HL-LHC:

- 3 types of PCBs:
 - **S** - 22 HV Feedthroughs (+ 2 protos of 18HVs)
 - **M** - 36 HV Feedthroughs
 - **L** - 42 HV Feedthroughs (+ 8 protos of 48HVs)

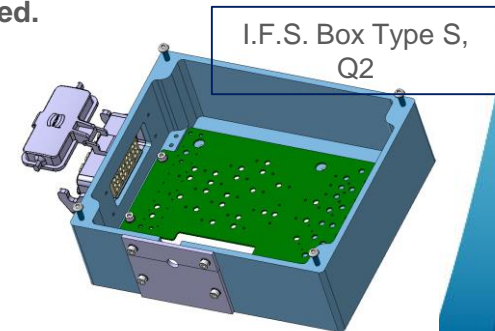
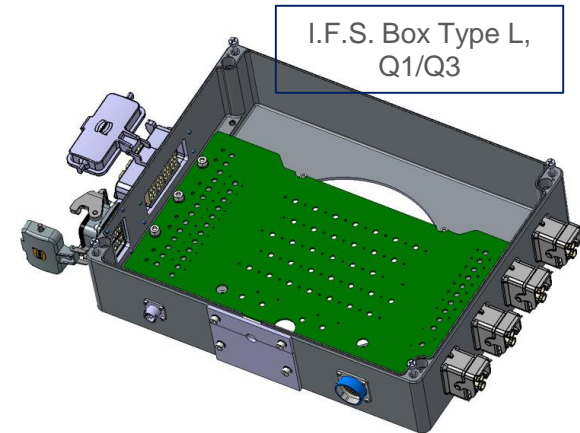
Entire PCB production for HL-LHC received and stored in MPE lab.

- 2 size of enclosures (alu. boxes):
 - **S** and **M** : 300 x 210 x 110 mm
 - **L** : 400 x 310 x 110mm

All aluminum enclosures needed for HL-LHC are stored. Some already machined.

- Variety of industrial connectors:
 - Industrial “Harting” types for magnet protection.
 - Industrial “military” type for cryogenic instrumentation.

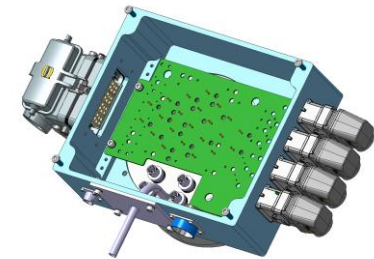
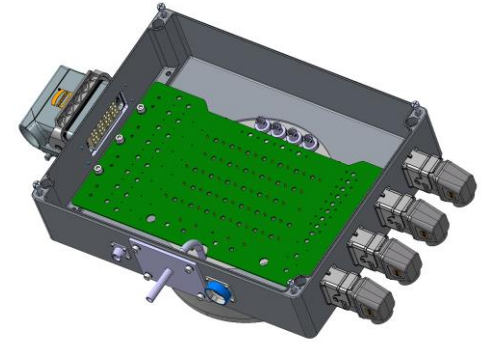
Partially received for the entire need of HL-LHC I.F.S boxes.



HL-LHC I.F.S. boxes integration

All I.F.S. boxes are designed and their integration has been verified in 3D model and also in real.

HL-LHC I.F.S. table: Updated Equipment Codes				
Diff type of IFS	MAGNETS	IFS NAME	HL-LHC I.F.S ASSEMBLY CDD NUMBER	NEW ASSEMBLY ST NUMBER
1	Q1A, Q3A	L TYPE A_Q1/Q3_A	LHCDIILQA0002	ST1585737
2	Q1B, Q3B	L TYPE A_Q1/Q3_B	LHCDIILQB_0001	ST1596890
3	Q2A/B	S TYPE B_Q2	LHCDIISQ_0002	ST1596910
4		L TYPE A_Q2	LHCDIILQC_0001	ST1596896
5	CP	L TYPE B_CP	LHCDIILC0002	ST1583713
6		M TYPE B_CP	LHCDIIMC0002	ST1584054
7	D1	S TYPE A_D1	LHCDIISB_0003	ST1596779
8	D2	M TYPE A_D2	LHCDIIMBA_0001	ST1596611
9		M TYPE C_D2	LHCDIIMBB_0001	ST1596768
10	DFX	L TYPE B_DFX	LHCDIILFA0002	ST1414412
11		L TYPE C_DFX	LHCDIILFB0002	ST1394121
12	DFM	L TYPE B_DFM	LHCDIILFC0001	ST1414415
13	DCM	M TYPE B_DCM	LHCDIIMF0002	ST1414424
14	CD	S TYPE C_CD	LHCDIISQD0002	ST1389398





HL-LHC I.F.S. boxes production

The production of HL-LHC I.F.S. boxes, including assembly, cabling and testing is performed in house at CERN.

We intend to keep the knowhow in house and be able to apply further modifications, if needed.

Each HL-LHC I.F.S. type will have a dedicated interface document describing the routing of the signals. Example of Q1, Q2 and Q3 here below.



EDMS NO. 2470513	REV. 1.2	VALIDITY DRAFT
---------------------	-------------	-------------------

REFERENCE : LHC-LMQXFAE-ES-0001



INTERFACE SPECIFICATION

HL-LHC MAGNET CIRCUIT FORUM

INSTRUMENTATION FEEDTHROUGH SYSTEMS FOR THE MQXFA MAGNETS

Abstract

This document presents the interface specifications of the quench detection and the instrumentation of the MQXFA magnet, and in particular the detailed pin-out and connection scheme of the Instrumentation Feedthrough System (IFS) boxes installed on the cold-mass assemblies. The information provided in this interface document reflects the instrumentation baseline as endorsed by the HL-LHC Instrumentation Review and the subsequent discussions and presentations held at the Magnet Circuit Forum (MCF) and the HL-LHC Technical Committee (TCC).



EDMS NO. 2749958	REV. 0.1	VALIDITY DRAFT
---------------------	-------------	-------------------

REFERENCE : LHC-LMQXFB-ES-0002

INTERFACE SPECIFICATION

HL-LHC MAGNET CIRCUIT FORUM

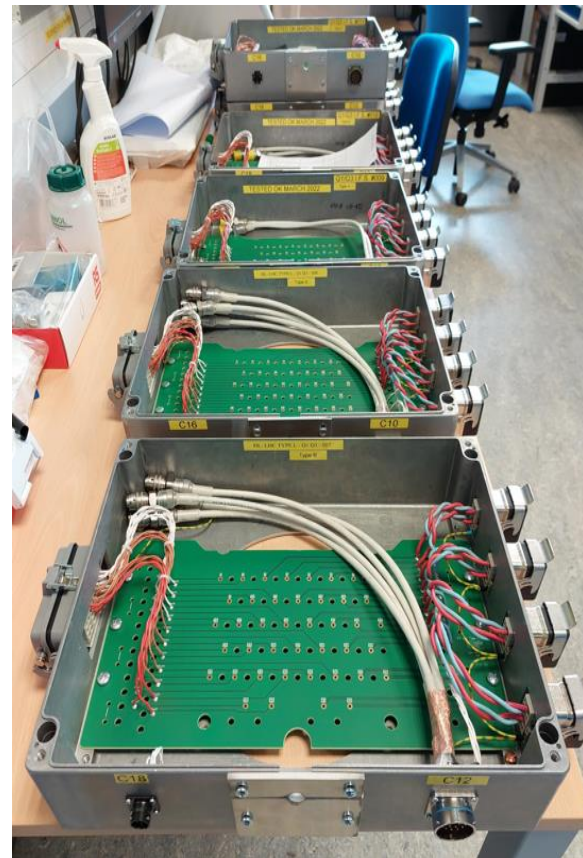
INSTRUMENTATION FEEDTHROUGH SYSTEMS FOR THE MQXFB AND MCBXFB MAGNETS (Q2A AND Q2B)

Abstract

This document presents the interface specifications of the quench detection and the instrumentation of the MQXFB and MCBXFB magnets, and in particular the detailed pin-out and connection scheme of the Instrumentation Feedthrough System (IFS) boxes installed on the cold-mass assemblies. The information provided in this interface document reflects the instrumentation baseline as endorsed by the HL-LHC Instrumentation Review and the subsequent discussions and presentations held at the Magnet Circuit Forum (MCF) and the HL-LHC Technical Committee (TCC).

HL-LHC I.F.S. boxes production

- I.F.S. boxes for Q1/Q3 delivered to AUP:
 - By Dec. 2021: 6 x I.F.S. boxes of 48 HVs (prototype flanges).
 - By July 2022: 4 x I.F.S. boxes of 42 HVs (series flanges).
- I.F.S. boxes for D2 Prototype delivered at CERN:
 - 1x I.F.S. prototype box of 52 HVs (prototype flanges).
 - 1x I.F.S. prototype box of 52 HVs (prototype flanges).
- I.F.S. boxes for MQXFB Prototype delivered at CERN:
 - 1x I.F.S. prototype box of 36 HVs (series flanges).



HL-LHC I.F.S. boxes production

- I.F.S. boxes stored in MPE lab:
 - 2x I.F.S. boxes for **Q1/Q3** of 42 HVs (series flanges).
 - 1x I.F.S. boxes for **Type L** for **Q2A/B** of 42 HVs (series flange).
 - 2x I.F.S. boxes for **Type S** for **Q2A/B** of 18 HVs (prototype flanges).
 - 1x I.F.S. boxes for **Type L** for **Corrector Package** of 42 HVs (series flange).
 - 1x I.F.S. boxes for **Type S** for **Corrector Package** of 22 HVs (series flange).
 - 1x I.F.S. boxes for **Type S** for **D1** of 22 HVs (series flange).
 - 2x I.F.S. boxes for **Type L** for **DFX** on bench F2 of 48 HVs (prototype flanges).
- In addition, 36 I.F.S. boxes have been shipped for machining and should be available at CERN by end of September 2022, for cabling, assembly and testing.



Conclusions

- Three types of series cover flanges will be used in the new HL-LHC I.F.S. called type L, M and S. The prototype flanges will be equivalent to the series ones from instrumentation point of view.
- Each series cover flange type will have a unique PCB.
- The aluminium enclosure will be of two sizes: Large for L-type and “LHC ones” for M and S-type of flanges.
- The instrumentation scheme and signal routing has been approved in agreement within WP7.
- The design of HL-LHC I.F.S. boxes is completed and series production started.
- Interface document is available for Q1, Q2 and Q3 magnets, and is under preparation for the other HL-LHC components.
- Production and testing of HL-LHC I.F.S. is kept in house by WP7.
- All HL-LHC I.F.S. boxes will be registered to MTF (InforEAM), ongoing task.

Thank you for your attention !