CERN 62-29
Proton Synchrotron Machine Division
8th October 1962

ORGANISATION EUROPÉENNE POUR LA RECHERCHE NUCLÉAIRE
CERN EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

CERN 19 INCH CHASSIS SYSTEMS

by

B. Sagnell

GENEVE
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CERN 19 INCH CHASSIS SYSTEMS

by

B. Sagnell

GENEVE
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Acknowledgements

Many people have been actively engaged in the construction and improvements of the chassis systems described in this report.

Of those most directly concerned, one should especially mention Mr. L. A. C. Dopping–Hepenstal who made the basic investigations of the various 19 inch rack and panel "standards", Mr. A. Oslund who designed the General Chassis System, Mr. U. Kracht who designed the Plug-in Chassis System, and Mr. H. R. Haeubi who designed the Plug-in Card System.

Mr. Kracht also played an important role in the preparation of this report, and has together with M. Mary and R. Haeubi kindly verified the new drawings.

The drawings were prepared by Miss G. Billon and Miss H. Flotow, who also made the technical illustrations.
PREFACE

The aim of this report is to provide - under one cover - all the necessary information required to build and to use the CERN chassis systems.

In the course of the work of condensing more than a hundred earlier drawings into those presented here, all dimensions have been verified for accuracy and errors corrected to obtain consistency throughout.

All tolerances have also been appraised and rationalised and in some cases made less stringent by the proper discrimination between important and unimportant dimensions, and by avoiding dimensioning the drawings in such a way that critical tolerances add together.

In most cases the necessary changes have been small, so no difficulties should be encountered if elements made from these drawings are combined with earlier types.

This report is intended as a reference manual for the users of the CERN chassis systems as well as a source of information for outside constructors of equipment for use at CERN.

For that reason, the 19 inch rack and panel standards are included and some basic design considerations explained.

Bengt Sagnell
An open 19 inch relay rack with typical CERN-built equipment. From top to bottom: An apparatus using PLUG-IN CARDS, three pieces of equipment constructed with PLUG-IN CHASSIS and two units using the GENERAL CHASSIS SYSTEM of construction.
Introduction to the 19-inch System of Construction

The majority of the world's electronic instruments are constructed behind front panels with a nominal width of 19 inches for mounting in telephone-type relay racks. This "19-inch standard" was then the natural choice also for instruments and racks to be produced by CERN, since both commercial and laboratory-made equipment would have to be used side by side.

Once the rack and panel dimensions are standardised, the method of constructing the supporting structure for the circuit elements behind the panels can also be normalised to speed up the work of constructing equipment. Such a structure — generally called a chassis — must give easy access to the individual circuit elements as well as allow for sufficient ventilation. For a chassis construction intended mainly for laboratory use, it is also necessary that the structure is flexible and easy to use, is simple to assemble without special tools and is economic to make and to store.

None of the classical methods of construction, e.g. the "inverted tray" type of chassis, fulfill these requirements, as early CERN models also showed, and a new chassis system was therefore designed using different principles. This GENERAL CHASSIS SYSTEM, of modular design, has been successfully employed ever since to the exclusion of almost any other type of construction. Recently, the system was expanded to allow for plug-in cards and for plug-in chassis, and the illustration to the left shows some typical instruments using these three systems of construction.

The 19-inch Rack and Panel Standard

Basically, 19 inch panels are nineteen inches wide, and other dimensions like height and position of fixing holes are determined by the use of a dimensional module of 1 3/4" (44.44 mm).

The actual dimensions must, however, differ slightly from the ideal figures because of necessary clearances and tolerances, and the resulting practical dimensions are not internationally standardised, although some national standards exist.

Upon closer investigation it is also found that panels differ sufficiently to give rise to difficulties when it comes to mounting equipment constructed in different countries in the same rack. The errors are caused either by the lack of a specific national standard, or by the rounding off of figures when converting inches to millimetres.
For the CERN panels, chassis and racks it was necessary to standardise such dimensions that CERN equipment would go into foreign racks, and that foreign equipment would fit the CERN racks.

On the two following pages are shown the different dimensions of racks and panels encountered in actual standards and equipment. The dimensions found to give a maximum of interchangeability are given under "CERN", and in choosing these dimensions production difficulties were considered and close tolerances avoided as much as possible.

The panel dimensions chosen for CERN are also given separately on drawing 1029-16-3 (last in the chapter on the General Chassis System), and agree closely with the American standard ASA C 83.9 (1956).

In compiling these tables, the following sources of information were used:

**REFERENCE**

1. UK: British Post Office, drawing No. 66410
2. UK: British Post Office, drawing No. 41575
3. USA: STANDARD, ASA C 83.9 (1956)
5. Sweden: STANDARD, SEN R 43 01 17 (1954)
6. Germany: STANDARD (proposed), DIN 41494 (1962)
7. France: CEA (Saclay), drawings
8. UK: AERE (Harwell), drawings
9. UK: Commercial Manufacturer
10. UK: Commercial Manufacturer
11. UK: Commercial Manufacturer
12. UK: Commercial Manufacturer
13. UK: Commercial Manufacturer
14. Holland: Commercial Manufacturer
15. Germany: Commercial Manufacturer
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## DRAWINGS

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</tr>
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<td>Sub-Chassis, width 2.5</td>
<td>1029-8-3</td>
</tr>
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<td>Sub-Chassis, width 3.5</td>
<td>1029-9-3</td>
</tr>
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<td>Connector Support, width 0.5</td>
<td>1029-10-3</td>
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<td>1029-11-3</td>
</tr>
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</tr>
<tr>
<td>Bracket</td>
<td>1029-13-3</td>
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<tr>
<td>Plate</td>
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<tr>
<td>Runner</td>
<td>1029-15-3</td>
</tr>
<tr>
<td>19-Inch Front Panels</td>
<td>1029-16-3</td>
</tr>
</tbody>
</table>
THE GENERAL CHASSIS SYSTEM

The illustration shows a typical assembly of those standard parts which together form the General Chassis System.

**Chassis elements**

The outside frame or CRATE is made up from eight aluminium section L-PIECES fastened to cast CORNERS by means of four rivets or screws in each end. A standard front panel can be fixed to any of the outer sides of the crate which has the full panel width, i.e., to at least any of four sides, or as in the illustrated case, to all six sides.

The lower half of the illustration shows how circuit-carrying, flat metal plate SUB-CHASSIS are mounted in the crate by means of T-PIECES, and how CONNECTOR SUPPORTS go between L-pieces.

Both connector supports and sub-chassis plates are made stiffer by having two sides turned up—high enough to get the necessary rigidity for mounting transformers and other heavy components, but low enough to allow the plate to pass under the tools of a punching press when making the mounting holes for components. To be able to discriminate the otherwise similar looking connector supports from sub-chassis without making actual measurements, the connector supports have the corners of the turned-up sides cut at an angle of 45°.

As shown previously, the front panels are available in different heights in steps of the basic 19 inch rack and panel module "unit" of 1 3/4" (44.44 mm). All chassis elements are designed in the same module, and their respective sizes are also recorded in "units," but not in absolute terms, but rather in the units of the front panel to which they belong.

These "units" or "size numbers" are used for convenience only. To make up a crate for a four-unit high front panel, one needs "four-unit" long L-pieces, and the crate will take "four-unit" Sub-Chassis, "four-unit" Connector Supports, "four-unit" T-pieces, etc.

Although the lengths of these chassis elements are all different and are not multiples of the basic module unit, each element shows a constant difference between one size number and the next of one unit (within 0.5 mm).

A study of the table 1029-2-4 will reveal how the system is built up, and this table should be consulted whenever a dimension of an element is in doubt, or when a special variation of the system is to be designed. It should be noted that size number 2 is a special case and does not follow the basic system.
Special elements

FLAT CORNERS, not shown in the illustration on the previous page, are used when an L-piece is to be mounted in between two other L-pieces where there is no normal corner. This part makes it possible to divide a crate into compartments, to mount short connector supports where otherwise long pieces would be necessary etc.

SCREENING PLATES can be made in order to cover the outer sides of the crate to protect the internal circuits against mechanical damage, or personnel against hazardous voltages etc. The plates are generally made to fit in between the four L-pieces of the side of the crate, and are fixed to the corners by screws in the existing holes. A solid rear plate is often used instead of individual connector supports.

The RUNNERS mounted under the crate make the chassis stand flat on a table, and make it easy to slide the chassis in and out on the steel PLATES and cast BRACKETS which can be mounted in the racks to simplify the handling of heavy chassis units (the brackets are visible on the photograph, page 2).

Ventilation

To obtain the best possible cooling of the internal circuits, the sub-chassis are anodised black, and should be mounted vertically.

Vertical mounting of all plates is necessary in order not to block the natural air flow through an enclosed rack. If this rule is followed, about one kilowatt dissipated in an enclosed rack filled with chassis units results in an inside temperature rise of not more than about twenty degrees. If a small ventilator is included to increase the air flow through the rack, the temperature rise can be limited to about five degrees.

The engineering drawings on the following pages (drawing numbers beginning with 1029-) show the basic chassis elements in full detail. Many special elements like screening plates, etc., have not been included, but the published information should make the task of designing such elements a relatively easy matter when the need arises.
Typical electronic instruments constructed from standard chassis elements. Note vertical, black sub-chassis.
GENERAL CHASSIS SYSTEM,
LIST OF DIMENSIONS

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<td>177</td>
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<td>266</td>
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<td>354,8</td>
<td>399,2</td>
<td>443,7</td>
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<tr>
<td>L</td>
<td>58</td>
<td>94</td>
<td>138,5</td>
<td>183</td>
<td>227,5</td>
<td>271,5</td>
<td>316</td>
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<td>121,2</td>
<td>165,7</td>
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<td>84,2</td>
<td>128,7</td>
<td>173,2</td>
<td>217,7</td>
<td>261,7</td>
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<td>149</td>
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<td>326,5</td>
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<td>—</td>
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<tr>
<td>S (R+8)</td>
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<td>97</td>
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[Diagram of chassis system with dimensions marked: P, L, H, Y, Z, C,T]
DIECASTING TOOL
HELD BY SUPPLIER
ALUMETALL GmbH.
NOPTISCHSTRASSE 71
NÜRNBERG
GERMANY

MATERIAL: ALUMINIUM ALLOY

GENERAL CHASSIS SYSTEM
CERN - MPS
1029-3-3
21 DECEMBRE 1961 GI
TOLERANCES: ±0.2 mm

MATERIAL ANTICORODAL B

GENERAL CHASSIS SYSTEM

FLAT-CORNER

CERN - MPS
1029-4-3
21 DECEMBRE 1961 G.
### Table: Type, T, Z, n, n x 22,22

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<th>n</th>
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**MATERIAL** ANTICORODAL B ANODISED

**GENERAL CHASSIS SYSTEM**

**T-PIECES (T)**

CERN-MPS 1029-6-3

27.6.62
MATERIAL ANTICORODAL A, ANODISED, BLACK

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GENERAL CHASSIS SYSTEM

SUB CHASSIS

WIDTH 25 (C 25)

CERN - MPS 1029-8-3

12 DECEMBRE 1961 GB
MATERIAL ANICORODAL A, ANODISED, BLACK

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GENERAL CHASSIS SYSTEM
SUB-CHASSIS
WIDTH 35 (C 3.5)

CERN - MPS 1029-9-3
13 DECEMBRE 1961 GE
**MATERIAL** ANICORODAL B, ALLEGA 2524
ANODISED, BLACK.

**GENERAL CHASSIS SYSTEM**
CONNECTOR SUPPORT
WIDTH 0.5 ( S 05 )

CERN - MPS 1029-10-3
11 DECEMBRE 1961
MATERIAL anticorodal A, anodised, black.

GENERAL CHASSIS SYSTEM
CONNECTOR SUPPORT
WIDTH 25 (S 25)

CERN - MPS
1029-12-3
7 DECEMBRE 1961 G

<table>
<thead>
<tr>
<th>TYPE</th>
<th>C</th>
<th>Z</th>
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<tr>
<td>S 25 x 3</td>
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<td>S 25 x 4</td>
<td>157</td>
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<td>S 25 x 10</td>
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TOLERANCE ON ALL DIMENSIONS: ±0.5

MATERIAL STEEL, CADMIUM PLATED

PLATE
FOR BRACKET 1029-13-3

CERN - MPS
1029-14-3
5 DECEMBRE 1961 GI
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<tr>
<th>TYPE</th>
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<tr>
<td>R 4</td>
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<tr>
<td>R 10</td>
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<td>395.2</td>
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MATERIAL ANTI-CORRODIAL B
ANODISED

ALLEGA SECTION No 3122

CERN-MPS
1029-15-3
15.1.62
PANEL AND SLOT DIMENSIONS

Position of fixing-holes for "CERN General Chassis" crates

<table>
<thead>
<tr>
<th>PANEL SIZE</th>
<th>P</th>
<th>x</th>
<th>y</th>
<th>z</th>
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<td>57,0</td>
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<td>4</td>
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<td>-</td>
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<tr>
<td>5</td>
<td>221,5</td>
<td>146,0</td>
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<td>10</td>
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<td>190,5</td>
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</tbody>
</table>

tolerances ±0,3

Position of fixing-holes for "CERN General Chassis" crates

<table>
<thead>
<tr>
<th>PANEL and CRATE SIZE</th>
<th>Hole - distance ( y \pm 0,2 )</th>
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<td>9</td>
<td>350,7</td>
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<tr>
<td>10</td>
<td>395,2</td>
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</tbody>
</table>
PLUG-IN CHASSIS SYSTEM

DRAWINGS

Assembly, Crate 1027-3-3
Assembly, Plug-in Unit 1027-4-3
Front Mounting Bracket 1027-5-3
L Special 1027-6-3
Upper Front Bar 1027-7-3
Text Strip 1027-8-3
Lower Front Bar 1027-9-2
Upper/Lower Rear Bar 1027-10-2
Connector Supports 1027-11-3
Guiding T 1027-12-3
Front Panels, width 1 1027-13-3
Back Plates, width 1 1027-14-3
Front Panels, width 2 1027-15-3
Back Plates, width 2 1027-16-3
Front Panels, width 3 1027-17-3
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Front Panels, width 4 1027-19-3
Back Plates, width 4 1027-20-3
Bar 1027-21-3
Locking Screw 1027-22-3
Plug-in Unit Dimensions 1027-23-3
PLUG-IN CHASSIS SYSTEM

L: 10 UNITS
L : 10 UNITES

UPPER REAR BAR
BARRE SUPERIEURE ARRIERE

L SPECIAL
L SPECIAL

LOWER REAR BAR
BARRE INFERIEURE ARRIERE

L: P UNITS
L : P UNITES

UPPER FRONT BAR
BARRE SUPERIEURE FRONTALE

CONNECTOR
CONNECTEUR

TEXT STRIP
PLAQUETTE DE TEXTE

CONNECTOR SUPPORT
SUPPORT POUR CONNECTEUR

P

GUIDING T
GUIDE EN T

LOWER FRONT BAR
BARRE INFERIEURE FRONTALE

FRONT MOUNTING BRACKET
CORNIERE DE FIXATION

RUNNER
GLISSIERE

HOLE FOR LOCKING SCREW
TROU POUR VIS DE BLOCAGE
THE PLUG-IN CHASSIS SYSTEM

This system was developed from the General Chassis System and uses the same crate structure, many of the same elements and the same dimensional module with the exception of those dimensions determined by the division of the front panel space into twelve new "panel width units".

Elements

The illustration shows an example of a chassis assembly for three LONG and one SHORT PLUG-IN UNIT. The total depth of the crate is standardised to ten chassis units, using a SPECIAL L-PIECE.

No normal front panel is used. Instead, two MOUNTING BRACKETS spaced by an UPPER and a LOWER FRONT BAR constitute a frame with standard 19 inch dimensions.

The lower front bar is drilled with holes for the LOCKING SCREWS of the plug-in units, and with the holes for the GUIDING T-PIECES which steer the units into position.

The UPPER and LOWER REAR BARS support the rear ends of the guiding T-pieces and the special CONNECTOR SUPPORTS, each carrying one connector.

THE PLUG-IN UNIT

Is made up of a FRONT PANEL and a BACK PLATE held together by four BARS.

The vertical distance between the bars was decided by the lengths of the standard SUB-CHASSIS, and the panel heights were chosen to allow for a 12 mm TEXT STRIP above all units.

The illustrated unit would fit into the second compartment from the right in the chassis crate shown.
The plug-in units are available in four different heights (3, 4, 5 and 6 units), in any panel width from 1 to 12 times the width of the narrowest unit (although normally only widths 1, 2, 3 and 4 are used), and in a long and a short version.

**Locking screw**

On the normal width plug-in units, only one locking screw is needed which also serves as a handle when withdrawing the unit. The hole in the middle of the screw takes a banana plug and makes a convenient earth point for external measuring instruments.

The screw is positioned on the centre line of those panels with an odd width-number, and half a unit off centre to the right on even-unit wide panels.

The connector which is mounted on line with and behind the locking screw is normally reserved for the power connections to the unit. Any other connector in the same unit can be used freely for signal connections.

**Connector**

The chassis system relies for its proper functioning on the fact that the necessary precision guiding of the mating connectors is done by guiding pins on the connectors themselves, not by any close tolerance guiding of the whole plug-in unit.

This limits the choice of suitable connectors, and the mechanical drawings show the cut-outs for those 24-pin Amphenol Blue Ribbon connectors chosen by CERN.

It should be noted that the floating mount of the female connector requires that the wiring be done with flexible leads of not too large diameter, since otherwise the self-adjusting action is lost.

**The System in Practical Use**

The fact that plug-in units will fit into chassis crates for which they were not originally intended poses a problem which must be considered, and which can be solved in different ways:

1. All units can be made completely electrically compatible so that they will function wherever they are used. This implies not only standardisation of the pin connections of the plugs, supply voltages, signal levels, polarities, driving impedances etc., but also a very large reserve of pins for future use which may only be employed after general agreement.

Such a scheme must be used for units inside a functional system to get the desirable interchangeability for which the chassis system was designed. However, it is not feasible on a larger scale since it requires an impractical amount of design coordination and standardisation to remain "pure".
A complete plug-in instrument showing good use of volume and panel space.

Below, some typical plug-in units. Ninety-six different sizes can be constructed from the basic chassis elements.
Some form of coding can be used to inform the user if a unit will or will not work in a certain chassis crate.

A simple coding—and necessary for other reasons—takes the form of TYPE numbers. The type numbering system can be very simple as long as functionally different units get different numbers. The compartments of the crates should then be marked with the type numbers of the units fitting that compartment, e.g., on the lower front bar. Note that the text strip above the units should be reserved for text explaining the function of the unit below, not the identity.

More elaborate mechanical coding of the units is also possible. The upper and lower edges of the Back Plates of the Plug-in Units may be slotted to allow vertical coding studs screwed into the upper and lower front bars to pass. An incorrectly coded unit will then be blocked by the studs.

Such a system may be desirable when similar looking units must not be interchanged inside a system.

**Modifications of the Basic System**

The chassis system as described can be modified to satisfy many special requirements. It is possible, for instance, to combine plug-in units and standard panels in one and the same crate, or to mount plug-in chassis crates and standard chassis crates on top of one another, thus forming equipment where the best of both types of construction are combined.

Each such construction must, however, be considered separately, since there are many ways of arriving at satisfactory solutions. The positions of the extra fixing holes required can generally be derived from the drawings, and the dimensions of specially made elements can be found either directly on the drawings of the standard elements, or derived from the table of basic dimensions 1029-2-4.

Drawing 10 27-23-3 lists all plug-in unit sizes up to the full width of 12 units and also gives all possible positions of fixing screws and connectors.

The engineering drawings on the following pages (drawing numbers beginning with 1027- ) show the additional elements required for the Plug-In Chassis System.

The following parts are taken from the General Chassis System without modifications: CORNERS, L-PIECES, SUB-CHASSIS, CONNECTOR SUPPORTS, RUNNERS.
DRILL ONLY IN 10-UNIT L-PIECE

394\( \pm \) 10 (10 UNITS)

305\( \pm \) 10 (8 UNITS)

MATERIAL: ANTI-CORODAL ANODISED
ALLEGRA SECTION No 633

HOLES A
FOR SCREW
VSM 12140
3mm

HOLES B
FOR POP
TAP K/423 BS

L SPECIAL

CERN-MPS 1027-6-3
9.1.62
* THESE HOLES IN LOWER REAR BAR ONLY

MATERIAL: ANTICORODAL ANODISED

ALLEGA SECTION No 39

PLUG-IN CHASSIS SYSTEM

CERN-MPS 1027-10-2
<table>
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<tr>
<th>HEIGHT (UNITS)</th>
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<th>b</th>
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<td>111</td>
<td>116.5</td>
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<td>4</td>
<td>155.5</td>
<td>161</td>
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<td>200</td>
<td>205.5</td>
</tr>
<tr>
<td>6</td>
<td>244.5</td>
<td>250</td>
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MATERIAL: ANTI-CORODAL

ALLEGRA SECTION No 2524

PLUG-IN CHASSIS SYSTEM

CONNECTOR SUPPORTS

CERN-MPS
1027-11-3
12.12.60/6
MATERIAL: ANTICORODAL B

PLUG-IN CHASSIS SYSTEM
FRONT PANELS
WIDTH 1

CERN-MP
1027-13-
PLUG-IN CHASSIS SYSTEM
FRONT PANELS
WIDTH 2
CERN-MP' 1027-15-

MATERIAL ANTICORODAL B

<table>
<thead>
<tr>
<th>HEIGHT (UNITS)</th>
<th>R</th>
<th>A</th>
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<tbody>
<tr>
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<td>89</td>
<td>120</td>
</tr>
<tr>
<td>4</td>
<td>133,5</td>
<td>164,5</td>
</tr>
<tr>
<td>5</td>
<td>178</td>
<td>209</td>
</tr>
<tr>
<td>6</td>
<td>222,5</td>
<td>253,5</td>
</tr>
</tbody>
</table>

31,5 \(0,01\) 31,5 \(0,01\)

\(\# 3,2/90^{\circ}\)

\(R \pm 0,1\) \(A \pm 0,1\)

61,8 \(0,01\)

3
Material: Anticorodal B

Front Panels
Width: 3

Dimensions:
- Height (Units)
  - 3: 89, 120
  - 4: 133.5, 164.5
  - 5: 178, 209
  - 6: 222.5, 253.5

Width: 107.8 ± 0.1

Angles:
- 32°/90°
PLUG-IN CHASSIS SYSTEM
BACK PLATES
WIDTH 3

CERN-MPS
1027-18-3

7 12 61
MATERIAL ANTICORODAL B

PLUG-IN CHASSIS SYSTEM

FRONT PANELS
WIDTH 4

CERN-MPS
1027-19-5
8.12.61
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<tr>
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<td>143.5</td>
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<td>188</td>
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<tr>
<td>6</td>
<td>222.5</td>
<td>232.5</td>
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MATERIAL ANTI-CORODAL B

PLUG-IN CHASSIS SYSTEM
BACK PLATES
WIDTH 4

CERN-MPS
1027-20-3
8.12.61/72
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<thead>
<tr>
<th>DRAWINGS</th>
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<tbody>
<tr>
<td>Assembly</td>
<td>1030-1-3</td>
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<tr>
<td>Front Panel (Chassis)</td>
<td>1030-2-3</td>
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<td>L-Piece, 6 units</td>
<td>1030-3-3</td>
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<tr>
<td>L-Piece &quot;A&quot;</td>
<td>1030-4-3</td>
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<tr>
<td>L-Pieces &quot;B&quot;</td>
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<tr>
<td>Sub-Panel, width 1</td>
<td>1030-6-3</td>
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<td>Sub-Panel, width 2</td>
<td>1030-7-3</td>
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<td>Sub-Panel, width 3</td>
<td>1030-8-3</td>
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<td>Sub-Panel, width 4</td>
<td>1030-9-3</td>
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<td>Plug-In Cards</td>
<td>1030-10-3</td>
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<tr>
<td>Card Mounting Angle</td>
<td>1030-11-3</td>
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<tr>
<td>Card Supporting Bars</td>
<td>1030-12-3</td>
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<tr>
<td>Handle</td>
<td>1030-13-3</td>
</tr>
<tr>
<td>Fixing Screw</td>
<td>1030-14-3</td>
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</tbody>
</table>
PLUG-IN CARD SYSTEM

POWER SUPPLY
ALIMENTATION

POWER SUPPLIES 30V
ALIMENTATIONS 30V

L: TYPE "A"

L: TYPE "B"

L: 6 UNITS
L: 6 UNITES

FRONT - PANEL
PLAQUE - AVANT

SUPPORTING BAR
BARRE DE SUPPORT

CARD
CARTE

ANGLE

PLUG-IN CARD UNITS
TIROIRS

HANDLE
POIGNEE

SUB - PANEL
PANNEAU

1030 - 1 - 3
THE PLUG-IN CARD SYSTEM (The "Nucleonic System")

This variation of the General Chassis System was introduced to satisfy the demand for a chassis to take printed circuit cards with front panels. The resulting construction is simpler and cheaper than the Plug-in Chassis System described in the previous section of this report, but it is also somewhat more limited in its use.

The illustration shows the chassis crate (called the "Power Supply") together with two types of PLUG-IN CARD UNITS.

The Chassis Crate

is made out of standard "General Chassis" components in size 4x6x10 units. This standard frame is fitted with a 19 inch panel with a cut-out for the plug-in card units and with holes for mains switch, fuses and indicator lamp. Inside the crate nine connectors are mounted by means of special L-section pieces (L"A" and L"B"), a solution made necessary since the dimensional module of the connector does not correspond to the module of the chassis system, thus precluding the use of standard T-section pieces, which are otherwise normally employed for mounting components in a crate.

The connectors follow American standard (88 pins, spacing 5/32") and are manufactured by several firms including ATI, Amphenol, Cannon and Method. Behind the connectors sufficient space is provided for power supply units and other common equipment.

The Plug-In Card Unit

consists of one or more CARDS mounted on SUB-PANELS of various widths. Only one size of card is made.

The rear end of each card is equipped with an 88-pin printed edge connector, and the rest of the card surface may either be insulated or copper-covered. The surface of the cards can be drilled with a matrix of holes based on the international standard grid module of 1/10" (2.54 mm), and the photograph shows how the circuit components are then mounted to the cards by means of solder turrets in these holes.

The cards are fixed to the sub-panels by means of intermediate angle pieces on the wider panels, or directly to the angled sides of the two narrowest types of panels. When the two largest sizes of panels are employed, a CARD SUPPORTING BAR should be used. This bar improves the mechanical stability of the card-unit, and it also locates the rear ends of the cards accurately. The cards can be fixed to the bar by means of wire loops through the holes in the bar and on the cards.

Application Notes

This chassis system was especially designed to allow different electronic instruments to be assembled out of pre-constructed, standardised plug-in units in a quick and rational way. Typical such functional units which together make up nucleonic instruments include Amplifiers, Discriminators, Coincidence Circuits etc.
The system is also well suited for experimental circuits intended to work with such standard units, and accepting the standard supply voltages which the Power Supply crate provides. At CERN, ±30V are used as chassis supply voltages, with lower voltages generally derived as required on the circuit cards themselves. Only the supply voltages are normally connected to the cards through the printed connectors, and all signals go through coaxial connectors mounted on the sub-panels (even between units in the same chassis).

The mechanical construction of the plug-in card unit does not offer the circuit elements much protection when the units are stored or handled outside the chassis crate. Also, the units are not mechanically guided into the mating connectors, which makes it necessary to exercise some care when they are installed. Whenever a more robust mechanical construction is required, the previously described Plug-In Chassis System should be employed. That system also allows many more (and bigger) plug-in units to be constructed, and the mechanical stiffness of the units is sufficient to allow even heavy components like mains transformers to be included. Used within its limitations, however, the Plug-In Card System finds many applications, especially for light-weight nucleonic instruments.

The engineering drawings on the following pages (drawing numbers beginning with 1030-) show the additional chassis elements required for the Plug-In Card System. The following parts are taken from the General Chassis System without modifications:

CORNERS, L-PIECES (L4, L10), T-PIECES, SUB-CHASSIS, CONNECTOR SUPPORTS, RUNNERS,
A Power Supply with some typical plug-in card units.
FOR PANEL DIMENSIONS (SIZE 4) AND
POSITIONS OF FIXING HOLES FOR CRATE
SEE DWG 1029 -16 - 3

PLUG-IN CARD SYSTEM
CERN - MPS
1030 -2 - 3
8. 6. 82 / 10

MATERIAL ANTICORODAL 4mm

FRONT PANEL (CHASSIS)
MOUNTING HOLES AS ON 1029 - 5 - 3

#3.4 / 120° (FOR RIVETS)

MOUNTING HOLES AS ON 1029 - 5 - 3

129 ± 0.1

173.5 ± 0.2

227.5 ± 0.2

6 ± 0.1

6 ± 0.1

MATERIAL ANTICORODAL B
ANODISED

ALLEGED SECTION N° M 633

PLUG-IN CARD SYSTEM

CERN-MPS

1030-3-3

L-PIECE, 6 UNITS

13 6. 62 / \$
MATERIAL: ANTICORODAL B
ANODISED

ALLEG A SECTION N° M 633

PLUG-IN CARD SYSTEM

L-PIECE "A"

CERN-MPS
1030-4-3
13.6.62/3
MATERIAL ANTICORODAL

ALLEGA SECTION N° 9750 (80x20x2)

PLUG-IN CARD SYSTEM
SUB-PANEL
WIDTH 1

CERN-MPS
1030-6-:
15.5.62/
HOLES FOR CARD MOUNTING ANGLE (S)

MATERIAL ANTICORODAL 2 mm
COPPER LAMINATED TYPE
CARD THICKNESS 1.8 mm
COPPER THICKNESS 105 μm
CONTACTS GOLD PLATED 5 μm
SHADED AREA GOLD FLAED "ATOMEX"
MATERIAL EPOXY G10 - 710

INSULATED TYPE
CARD THICKNESS 1.8 mm
COPPER THICKNESS 35 μm
CONTACTS GOLD PLATED 5 μm
MATERIAL EPOXY G10 - 710

PLUG-IN CARD SYSTEM
PLUG-IN CARDS
CERN-MPS
1030-10-3
26.6.62 / 62