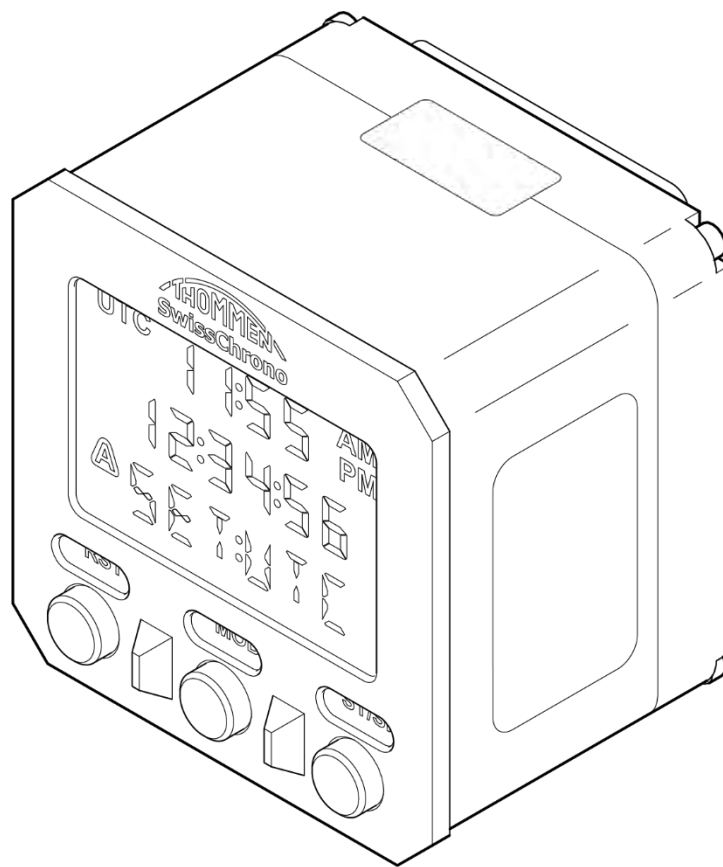# INSTALLATION AND OPERATING MANUAL

CM20 DIGITAL CHRONOMETER

ATA 31-22-10

Revision: 1.9

20/10/2022

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RECORD OF REVISIONS

Rev.	Date	Reason for Revision	Prepared	Checked	Approved
1.0	FEB 2/2012	Initial Issue	T. Rolls	-	T. Balazs
1.1	FEB 9/2012	Different paragraphs updated	T. Balazs	-	T. Balazs
1.2	MAR 19/2012	Illustrations updated	T. Balazs	-	T. Balazs
1.3	MAR 19/2012	Table "Preparation" removed	T. Balazs	-	T. Balazs
1.4	MAY 31/2012	Environmental Quality Test cat. ZN (DO-160F, Sect. 19) added; Bonding bolt modified (from M4 to M5)	T. Balazs	-	T. Balazs
1.5	MAY 26/2014	Type identification drawing corrected	T. Balazs	-	T. Balazs
1.6	DEC 2/2016	Thommen Logo and address changed. Page layout Changed. Minor Editing changes. ATA Format included	A. Anwar	-	S. Jaquier
1.7	OCT 15/2018	Battery replacement procedure added to Page Block 201.	M. Sreetharanathan	-	A. Anehila
1.8	APR 29/2022	Document reformatted. MID number removed (1515). DIP switch information either changed or removed in order to retract authorisation of the customer to change the settings. General corrections and improvements.	J. Garrett	G. Schaffner	A. Savin
1.9	OCT 20/2022	Operational Limitations (Sect. 1.5) was updated to clarify shelf-life time	J. Garrett	G. Schaffner	A. Savin

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SERVICE BULLETIN LIST

SB No.	Subject	Rev.	Date

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LIST OF EFFECTIVE PAGES

SECTION	PAGE	REV.	DATE		SECTION	PAGE	REV.	DATE
Title Page	1		20/10/22		Description and Operation	1		20/10/22
	2		20/10/22			2		20/10/22
						3		20/10/22
						4		20/10/22
						5		20/10/22
Record of Revisions	1		20/10/22			6		20/10/22
	2		20/10/22			7		20/10/22
						8		20/10/22
						9		20/10/22
						10		20/10/22
Service Bulletin List	1		20/10/22			11		20/10/22
	2		20/10/22			12		20/10/22
List of Effective Pages	1		20/10/22					
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						403		20/10/22
						404		20/10/22
Maintenance Practices	201		20/10/22					
	202		20/10/22					
	203		20/10/22		Adjustment / Test	501		20/10/22
	204		20/10/22			502		20/10/22
	205		20/10/22					
	206		20/10/22					
	207		20/10/22					
	208		20/10/22		Inspection / Check	601		20/10/22
	209		20/10/22			602		20/10/22
	210		20/10/22					
	211		20/10/22					
	212		20/10/22					
	213		20/10/22					
	214		20/10/22					

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<u>**INTRODUCTION**</u>

1.   Purpose of this Manual

This Installation and Operating Manual (INSOP) gives a description of the CM20 Digital Chronometer and the necessary procedural steps to remove/install, inspect and maintain the equipment. It also gives the mechanical and electrical characteristics to make sure that it is compatible with the aircraft.

For detailed operating instructions, refer to the User Operational Manual (CM20-USOM).

For repair procedures, refer to the Component Maintenance Manual (CM20-CMM), ATA 31-22-10.

Only Thommen Aircraft Equipment AG are permitted to repair the CM20 Digital Chronometer.

2.   Manual Description

The page blocks in this manual comply with the Air Transport Association of America (ATA) specification i2200.

3.   Revisions

Thommen Aircraft Equipment AG (TAE) gives the customers (that have a product guarantee) a complete revised manual when a change is included in a manual. The Record of Revisions section gives the reason for the changes done in the current revision.

A documentation revision service (with a customer portal) is also available for customers that have instruments/devices no longer covered by a product guarantee. This can be useful when an upgrade to the instrument/device can improve the operational life and/or reliability of older products.

The documentation revision service also includes the necessary Service Bulletins that upgrade/modify the device.

4.   Warnings, Cautions and Notes

4.1   Warnings

WARNING: **WARNINGS ARE GIVEN IN THE RELEVANT PAGE BLOCKS TO TELL PERSONNEL ABOUT SOMETHING THAT CAN CAUSE INJURY TO THEM. WARNINGS ARE GIVEN IMMEDIATELY BEFORE THE APPLICABLE TEXT TO WHICH THEY REFER.**

4.2   Cautions

CAUTION: CAUTIONS ARE GIVEN IN THE RELEVANT PAGE BLOCKS TO TELL PERSONNEL ABOUT SOMETHING THAT CAN CAUSE DAMAGE TO THE EQUIPMENT. CAUTIONS ARE GIVEN IMMEDIATELY BEFORE THE TEXT TO WHICH THEY REFER.

4.3   Notes

NOTE: Notes give helpful information to the personnel doing the task. Notes are included before or after the text to which they refer.

5.   Technical Support

Please contact Thommen Aircraft Equipment AG at the address given below for technical support.

THOMMEN AIRCRAFT EQUIPMENT AG

Hofackerstrasse 48
CH-4132 Muttenz
Switzerland

Phone: +41 (0)61 965 22 22

Email: tech-support@thommen.aero

Internet: www.thommen.aero

6.   Installer Responsibility

The installer is responsible for the correct installation of the equipment. This includes the mechanical and electrical configuration and compatibility with the aircraft.

All installation personnel must be fully qualified and approved to do the work procedures given in this Installation and Operating Manual (INSOP).

7.   Maintenance

Only Thommen Aircraft Equipment AG (or an approved service facility) are authorised to perform maintenance tasks not given in this manual.

8.   Document/Equipment Feedback

The Document / Equipment Defect Report (on the next page) gives the customer a way to inform Thommen Aircraft Equipment AG about any defects regarding the equipment or discrepancies in the technical documentation. This feedback will help Thommen Aircraft Equipment AG to make continued improvements to the equipment and/or the technical documentation.

DOCUMENT / EQUIPMENT DEFECT REPORT			
Aircraft Type	**Serial No.**	**Manual No.**	**Operator**

Date	**Reported By**	**Contact Details**

Document / Equipment:	
Description of Defect:	

Corrective action taken to continue operation:

Please send to:

THOMMEN AIRCRAFT EQUIPMENT AG
Hofackerstrasse 48
CH-4132 Muttenz
Switzerland

Telephone: +41 (0)61 965 22 22

Email: tech-support@thommen.aero

9.   List of Abbreviations

Abbreviation	Description
AMM	Aircraft Maintenance Manual
ARINC	Aeronautical Radio Incorporated
ATA	Air Transport Association of America
AWG	American Wire Gauge
CG	Centre of Gravity
CMM	Component Maintenance Manual
CM20	CM20 Digital Chronometer
DIP	Dual In-line Package
EASA	European Union Aviation Safety Agency
EEC	European Economic Community
EPROM	Erasable Programmable Read-Only Memory
ERR	Error
ET	Elapsed Timer
ETD	Elapsed Timer Down
FAA	Federal Aviation Administration
FED-STD	Federal Standard
FT	Flight Timer
FTA	Flight Timer Alarm
HIRF	High Intensity Radiated Fields
INSOP	Installation and Operating Manual
I/O	Input/Output
LCD	Liquid Crystal Display
LCS	Lighting Control Signal
LT	Local Time
MFD	Manufactured
MID	Master Identification Number
MIL	Military
MOD	Modification (also Mode)
MoO	Mode of Operation
MTBF	Mean Time Before Failure
MTH	Maintenance Timer in Hours
NRB	NVIS Radiance Requirements for Class B Equipment
NVIS	Night Vision Imaging System
P/N	Part Number
PWM	Pulse-Width Modulation
REV	Revision

Abbreviation	Description
RH	Relative Humidity
RMS	Root Mean Square
RS	Recommended Standard
RST	Reset
RTCA	Radio Technical Commission for Aeronautics
RX	Receive
SAE	Society of Automotive Engineers
SB	Service Bulletin
SER No	Serial Number
ST/SP	Start/Stop
TAE	Thommen Aircraft Equipment AG
TX	Transmit
USOM	User Operational Manual
UTC	Universal Time Coordinated
VAC	Volts Alternating Current
VDC	Volts Direct Current
WoW	Weight-on-Wheels

DESCRIPTION AND OPERATION

1.   General

1.1   Introduction

The Description and Operation (page block 1) of this manual gives a description of the functionality and operation of the CM20 Digital Chronometer.

The CM20 Digital Chronometer is a Thommen Aircraft Equipment digital chronometer, type CM20, from a production line 'Aircraft Clocks and Chronographs'.

The CM20 Digital Chronometer is a precision, multi-functional digital chronometer that shows the time and has various timer functions. It is normally installed in the aircraft cockpit, on the instrument panel.

1.2   Equipment Identification

The equipment identification and qualification labels on the CM20 Digital Chronometer comply with the requirements of MIL-STD-130 and Sub-part Q of EASA Part 21.

Each CM20 Digital Chronometer has an identification label (showing equipment identification data) and a qualification label (showing qualification and electrical/mechanical data), attached to the left and right sides of the housing.
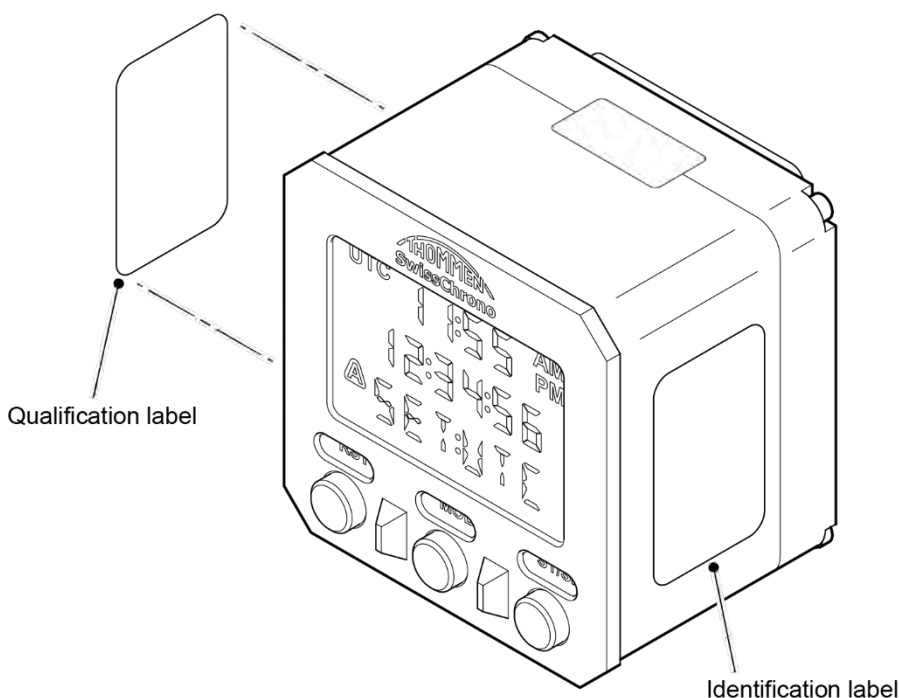

Figure 1 – Identification and Qualification Labels

DESCRIPTION AND OPERATION

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1.3   Specifications and Standards

The CM20 Digital Chronometer complies with the latest civil and military avionic standards, as shown in the following tables:

Reference	Description
EASA/Part 21	EC/Commission Regulation (EC) No 1702/2003 Annex Part 21 - Certification of aircraft and related products, parts and appliances, and of design and production organizations
EASA/Part 21 Sub-part K	Parts and Appliances Airworthiness
FAA/AC 20-94A	Digital Clock Installation in Aircraft
FAA/AC 20-158	The Certification of Aircraft Electrical And Electronic Systems for Operations in the High Intensity Radiated Fields (HIRF) Environment

Table 1 – Certification Standards

Reference	Description
MIL-C-81774	Military Specification, General Requirements for Aircraft Control Panel
MIL-P-7788	Panel, Information, Integrally Illuminated
MIL-STD-810	Environmental Test Method and Engineering Guidelines
MIL-STD-1472	Human Engineering
MIL-STD-3009	Lighting, Aircraft, Night Vision Imaging System (NVIS) Compatible
MIL-HDBK-217	Reliability Prediction of Electronic Equipment
MIL-STD-130	Identification Marking

Table 2 – MIL Standards

Reference	Description
ARINC 665-1	ARINC Report - Loadable Software Standards
Council Directives 76/769/EEC	Council Directives 76/769/EEC - On the approximation of the laws, regulations and administrative provisions of the Member States relating to restrictions on the marketing and use of certain dangerous substances and preparation
EIA/RS-232-C	Interface Between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange
FED-STD-595	Colours
INT/POL/27&29/1	Protection from the effects of HIRF
MODBUS API Specification	MODBUS Application Protocol Specification
MODBUS over Serial Line Specification	MODBUS over Serial Line Specification an Implementation Guide
Montreal Protocol	Annex C of the Montreal Protocol
RTCA/DO-160	Environmental Conditions and Test Procedures for Airborne Equipment
RTCA/DO-178	Software Considerations in Airborne Systems and Equipment Certification
RTCA/DO-254	EUROCAE ED-80/RTCA DO-254 Design Assurance Guidance for Airborne Electronic Hardware
RTCA/DO-268	Concept of Operations, NVIS for Civil Operators
RTCA/DO-275	Minimum Operational Performance Standards for Integrated NVIS Equipment
SAE/AS18012	Markings for Aircrew Station Displays Design and Configuration of
SAE/ARP4754	Certification Consideration for Highly-Integrated or Complex Aircraft Systems
SAE/ARP5413	Certification of Aircraft Electrical and Electronic system for the Indirect Effect of Lightning

Table 3 – Other Standards

1.4 Environmental Specifications

The CM20 Digital Chronometer complies with environmental specifications as shown in the table below:

Conditions	Reference	Category	Test Description
Illumination Qualification			Illumination performance is measured from outside the CM20 perpendicular to the display area.
Temperature & Altitude	RTCA/DO-160F section 4.0	B2Z	
Temperature Variation	RTCA/DO-160F section 5.0	B	
Humidity	RTCA/DO-160F section 6.0	B	
Operational Shocks and Crash Safety	RTCA/DO-160F section 7.0	B	
Vibration	RTCA/DO-160F section 8.0	U2	
Explosive Atmosphere	RTCA/DO-160F section 9.0	E	
Waterproofness	RTCA/DO-160F section 10.0	W	
Fluids Susceptibility	RTCA/DO-160F section 11.0	F	
Sand and Dust	RTCA/DO-160F section 12.0	S	
Fungus Resistance	RTCA/DO-160F section 13.0	F	
Salt Fog	RTCA/DO-160F section 14.0	S	
Magnetic Effect	RTCA/DO-160F section 15.0	Y	
Power Input Allocation	RTCA/DO-160F section 16.0	ZI	
Voltage Spike	RTCA/DO-160F section 17.0	A	
Audio Frequency Conducted Susceptibility	RTCA/DO-160F section 18.0	Z	
Induced Signal Susceptibility	RTCA/DO-160F section 19.0	ZC and ZN	
Radio Frequency Susceptibility	RTCA/DO-160F section 20.0	RR	
Emission of Radio Frequency Energy	RTCA/DO-160F section 21.0	M	
Lightning induced Transient Susceptibility	RTCA/DO-160F section 22.0	A3H33	
Lightning Direct Effects	RTCA/DO-160F section 23.0	X	
Icing	RTCA/DO-160F section 24.0	X	
Electrostatic Discharge (ESD)	RTCA/DO-160F section 25.0	A	
Fire, Flammability	RTCA/DO-160F section 26.0	C	
Vibration During Transport	MIL-STD-810F Method 514.5	--	
Solar Radiation Test	MIL-STD-810F Method 505.4	Procedure I	

Table 4 – Environmental Specifications

1.5   Operational Limitations, Range and Tolerances

At an ambient temperature of 25°C, the clock and timer readings maintain an accuracy of +/- 0.2 seconds per 24 hours (whilst in operation). At an ambient temperature of -45°C to 55°C, the clock and timer readings may deteriorate but will maintain an accuracy of +/- 2 seconds per 24 hours (whilst in operation).

The CM20 Digital Chronometer does not exceed a failure rate of 0.05 per 1000 operating hours during normal mode of operation. Failure of the CM20 will not cause hazardous or catastrophic conditions.

The mean time between failures (MTBF) is not in excess of 20,000 hours of operation (not in storage mode of operation).

The CM20 Digital Chronometer has a service life of not less than 4,000 flying hours, corresponding to 68,000 operating hours, based on the average annual aircraft utilization rate being scheduled at 250 flying hours.

With the battery installed, the shelf-life is 5 years. With the battery removed, the CM20 does not have any shelf-life limitation.

2. Description

2.1 Physical Description

The CM20 Digital Chronometer has an aluminium, 2" semi-ARINC housing with rounded edges. The maximum size of the CM20 is shown below. The front face of the CM20 is 3mm larger than the housing to fit flush against an aircraft instrument panel.
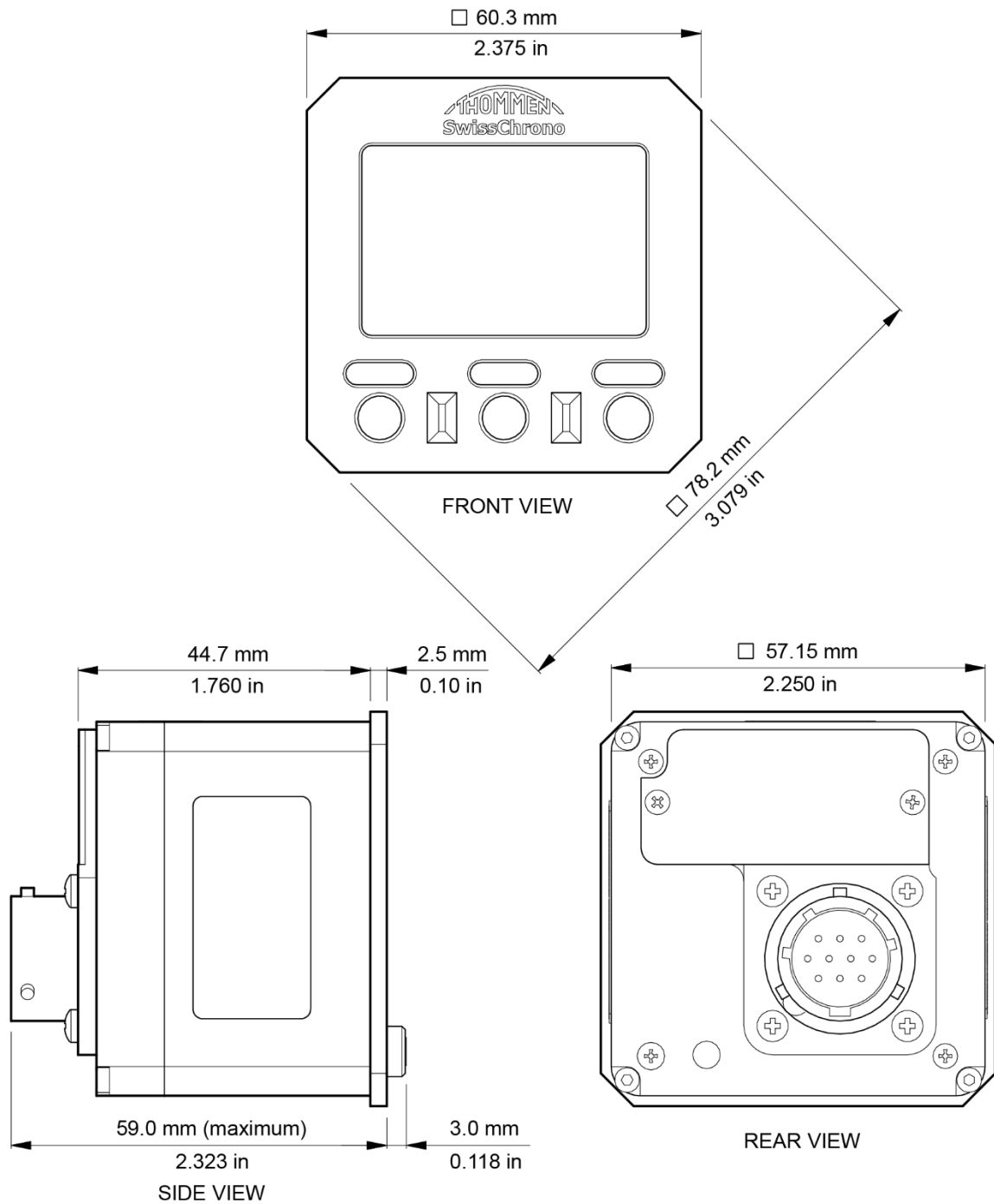

Figure 2 – CM20 Digital Chronometer – Physical Dimensions

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2.2 Electrical Description

A serial data interface supports the remote control and maintenance of the CM20 Digital Chronometer. This interfaces with the aircraft via a single electrical connector. A test box can be connected to the serial data interface for equipment initialization and acceptance testing.

A battery (CR1225) makes sure that the CM20 Digital Chronometer continues operation when aircraft electrical power is not available. The battery is located behind a battery access panel, at the rear of the CM20.

The CM20 Digital Chronometer does not have a circuit breaker or fuse to protect it against electrical surges or short circuits. It is designed to make sure that in the event of an electrical surge/short circuit, it will not be damaged or cause an unsafe condition. Incorrect DC power polarity will also not damage the CM20.

Received data signals must be compliant with RS-232 serial interface standard. The serial data interface operates at 9600 baud, no parity, 8-characters and 1 stop bit.

2.3 Weight and Balance

The CM20 Digital Chronometer has a maximum weight of 210 grams. The centre of gravity (CG) is within the CM20 housing body.

2.4 Materials

The CM20 Digital Chronometer is manufactured from non-flammable and self-extinguishing materials. Metallic components are corrosion resistant. The non-metallic components are resistant to lubricating oil, grease, preservative compounds and fuel, within the operating temperature limits.

2.5 Surface Finish

The front and sides of the front bezel of the housing for the CM20 Digital Chronometer are finished in 'Flat Black' (FED-STD-595, colour number 37038). The rear side of the bezel and the main body of the housing, where the mounting clamp is attached, are not painted.

2.6   Push Buttons

The CM20 Digital Chronometer push buttons are 9.5mm in diameter and are spaced 13mm apart. The push buttons require an actuation force of 690 (+/- 140) grams and provide a positive, tactile feedback when pressed.

The movement of the push buttons is 0.7 (+/- 0.15) mm.

The legend characters for the push buttons are Class A, Type 1, in accordance with SAE-AS18012 (Futura Medium Condensed).

The push buttons have the following functions:

- The left push button, with legend 'RST', is used to select the RESET function.

- The middle push button, with legend 'MOD', is used to select the MODE function.

- The right push button, with legend 'ST/SP', is used to select the START/STOP function.

2.7   Display Area

The display area of the CM20 Digital Chronometer is 44mm wide and 29.5mm high. The display is a negative image liquid crystal display. The segments of the display have characters that are transparent/opaque, surrounded by black.

The display area is divided into three lines; the top line, the middle line and the bottom line (mode line). The display area is readable in a horizontal plane from left and right, at an angle of up to 45⁰ from the centre of the display. Vertically, it is readable at 0⁰ to +45⁰ above the centre of the display.
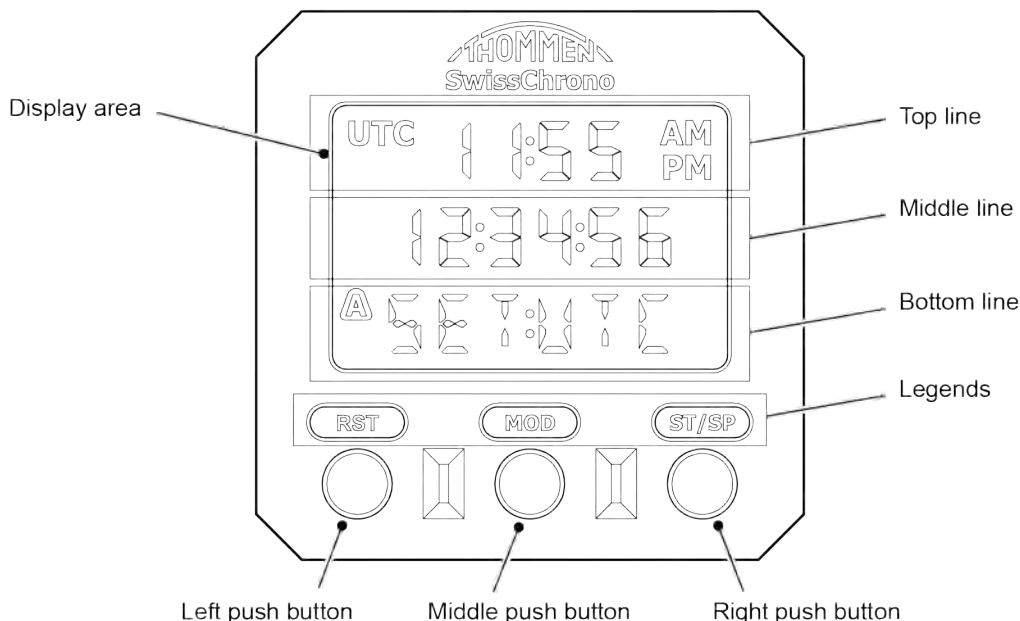

Figure 3 – CM20 Digital Chronometer – Front View

2.8 Lighting Description

In day mode the CM20 push button legends and display area segments are backlit in green colour on a black background (FED-STD-595, colour number 37038).

The push button legends, if not illuminated from behind (backlit), are white (FED-STD-595, colour number 37925) on a black background (FED-STD-595, colour number 37038).

In day mode the display area segments provide a uniform luminance of 14 fL +/- 0.1 fL.

The button legends are uniform at a level of 0.4 fL to 1.0 +/- 0.5 fL, depending on the luminance level carried in the lighting control signal operation.

Lighting Components	NRB	fL
Electronic and electro-optical display (monochromatic LCD)	1.7 E-10	0.1

The NVIS lighting legend push buttons are designed to limit spectral radiance, in accordance with MIL-STD-3009 requirements, when measured at the specified luminance level:

NVIS Colour	u'	v'	r	fL
NVIS Green A	.131	.623	.057	0.1

2.9 Software

The CM20 Digital Chronometer contains a Flash EPROM with a factory installed software configuration.

Safe operation of the software is checked by a watchdog timer. The watchdog timer is a hardware mechanism that is serviced by the software on a periodic basis. If the software corrupts and fails to service the watchdog timer, the processor will be reset, and the software reinitialized as if from a power-on reset.

The software does not make use of dynamic memory allocation or functional recursion.

3.   Operation

This section gives a brief description of the operation of the CM20 Digital Chronometer. For detailed operating instructions, refer to the User Operational Manual (CM20-USOM).

3.1   Functional Description

The CM20 Digital Chronometer provides a dual time zone clock display and several timer capabilities, including:

- 24 hour clock for universal coordinated time (UTC) or local time (LT) in 12/24 hour format

- Flight timer (FT) with pre-settable alarm (FTA)

- Up or down counting elapsed timer (ET/ETD)

- Simultaneous display of clock and either elapsed or flight timer readings

- ETD and FTA with a common switching output for an external signalling device

- Maintenance timer (MTH)

- Flight timer (FT and MTH) remotely controlled by a configurable switch input

- Remote setting functions via serial link (RS-232) in master and slave mode

- Lighting dimming curve for day and night mode

- Lighting order options (white/white, white/red, white/green NVIS A and B)

- Comprehensive built-in test with internal maintenance and failure log

NOTE:
The configuration of the CM20 Digital Chronometer is set using the DIP switches in accordance with the customer's requirements and must not be changed.

3.2   Operation Modes

After power is supplied to the CM20 Digital Chronometer (without user input or fatal start error), the CM20 starts to operate in the normal mode of operation (MoO).

If the battery cannot provide enough power to ensure safe storage of CM20 values during aircraft power OFF time, such as time data and maintenance timer hours (MTH), a warning message is displayed in the bottom line of the display during the startup phase. The warning messages are as shown below:

Message	Definition
BAT: LOW	Battery capacity is low, replace soon
BAT: DEF	Battery capacity is very low, replace immediately

After 5 seconds, the warning disappears and the CM20 continues to operate.

3.3   Night Vision Operation

The CM20 Digital Chronometer, when operated in night mode, fulfils the conditions defined for NVIS Green A, Type I, Class B.

The NVIS ability of the CM20 can be influenced by a maintenance operation, for example when a new lighting curve is implemented. After such a modification, the NVIS compatibility must be tested to avoid unexpected behaviour during flight.

3.4   Continued Airworthiness

There is no scheduled maintenance throughout the service life of the CM20 Digital Chronometer, except for the replacement of the battery. Removal and installation of the battery is given in Maintenance Practices, page block 201.

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FAULT ISOLATION

1.   General

Due to its robustness and simplicity, the CM20 Digital Chronometer is expected to work in almost every flight condition without problems. In the event that an internal error occurs, the CM20 will automatically cease to operate and display an error message.

If the error persists the next time power is applied, remove the CM20 and replace it with a new or repaired one from Thommen Aircraft Equipment AG (or an approved service facility).

2.   Error Codes

If an error occurs, the CM20 Digital Chronometer will display an error code and stop operating. In this situation, the top line will display '--:--', the middle line '--:--:--' and the bottom line 'ERR:<Error code>'.

The following 3 digit error codes are currently detected and displayed by the CM20:

Error Code	Description
001	Battery not detected

If the CM20 Digital Chronometer is not operating due to an error, it will not have any influence on other cockpit instruments.

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MAINTENANCE PRACTICES

1.   Installation and Design Considerations

1.1   Possibilities of Installation

The customer decides on the installed location of the CM20 Digital Chronometer, where an electrical power supply is available and good attachment of the mounting clamp is possible.

The CM20 Digital Chronometer is normally installed on the instrument panel of the aircraft cockpit/flight compartment.

Only fully qualified aircraft electrical technicians are permitted to install the CM20 Digital Chronometer.

1.2   Installation Features and Options

Additional equipment such as circuit breakers and fuses should be considered when installing the CM20 and its installation components for power protection and installation preferences.

The CM20 Digital Chronometer is electrically connected to the aircraft with a single 10-pin electrical connector (ref. Figure 201).

The connector provides interface connectivity for:

- Aircraft power and grounding
- Day/night light dimmer inputs
- Weight-on-wheels (WoW) signal input
- Alarm signal output

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1.3   Electrical Connectors

The CM20 Digital Chronometer is fitted with the following electrical connector (ref. Figure 201):

P/N	Type	Function
MS3112E12-10P	MIL-38999J	Power, Signal, Control

The CM20 Digital Chronometer requires the following mating electrical connector on the aircraft for installation (ref. Figure 201):

P/N	Type	Function
MS3116E12-10S	MIL-38999J	Power, Signal, Control
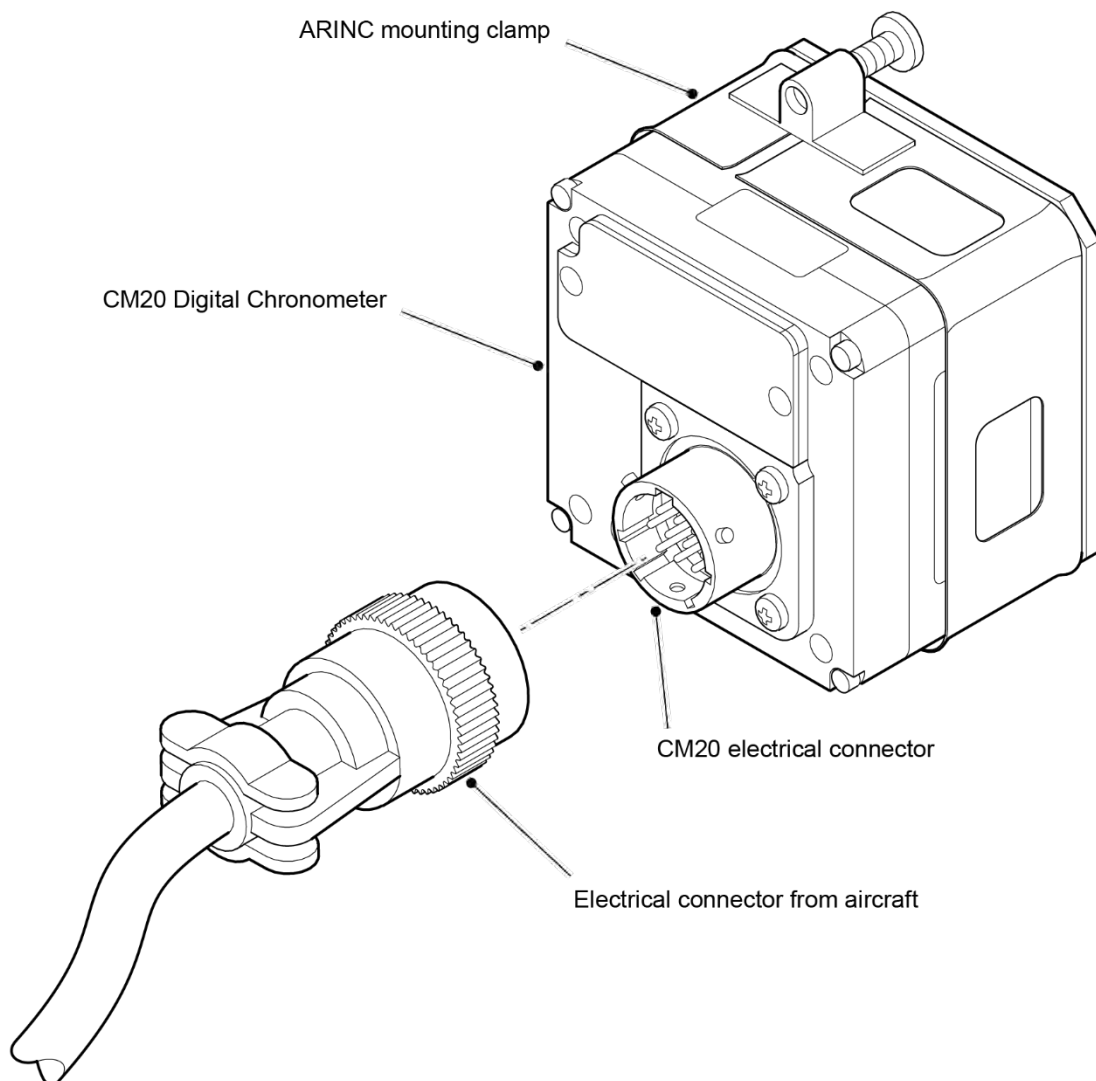
Figure 201 – Electrical Connectors

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MAINTENANCE PRACTICES

Sockets M39029/32-259 shall be used at the aircraft mating connector.

Size 20 AWG wire shall be used (typically Raychem 55A0811-20-9) to interface the aircraft systems to the aircraft mating connector at the cockpit control panel installation position.

Do not pass aircraft cable-shield through the connector to earth in the CM20 (except where grounded coaxial pins are used).

The aircraft cable-shield must be earthed via the connector back shell to the CM20 housing. The maximum bonding resistance between the cable-shield and the connector back shell shall be 5mΩ.

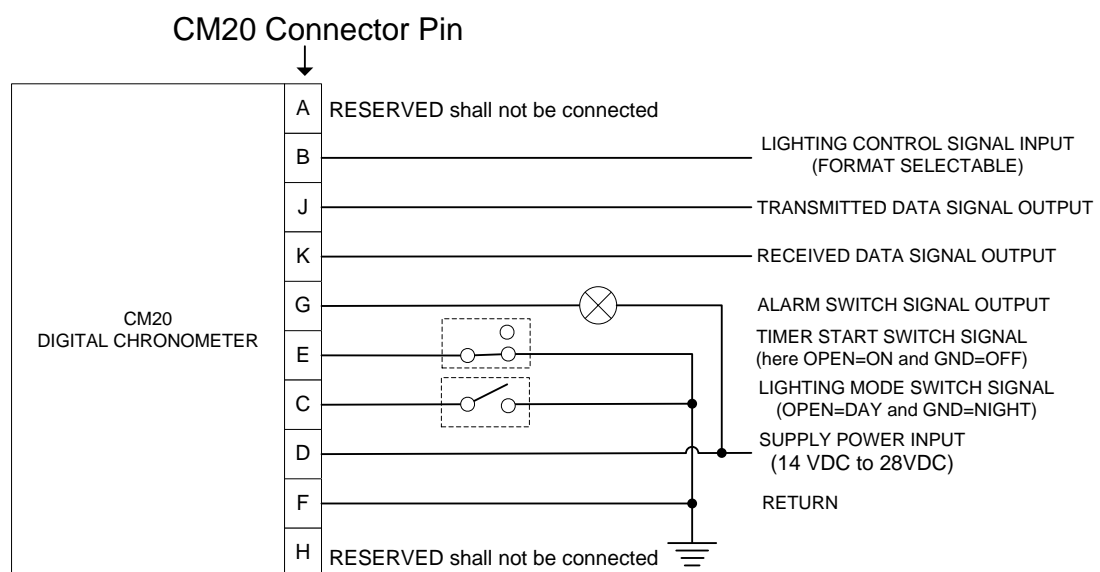The CM20 Digital Chronometer electrical connector pins are as shown below:

Figure 202 – Pin Connections on CM20 Electrical Connector

Pin	Function	I/O	Comments
A	RESERVED	-	Do Not Connect
B	LIGHT CONTROL	I	Lighting Control Signal
C	DAY/NIGHT MODE SENSE	I	Lighting Mode Switch Signal
D	14 / 28 VDC IN	Power	Supply Power
E	FLIGHT	I	Timer Start Switch Signal
F	RETURN	Power	Return - Data Signal/Supply Power/Lighting Control
G	ALARM OUT	O	Alarm Switch Signal
H	RESERVED	-	Do Not Connect
J	TX DATA	O	Transmitted Data Signal
K	RX DATA	I	Received Data Signal

Table 201 – Pin Connections on CM20 Electrical Connector

1.4   Master-Slave Configuration

If multiple CM20 devices are installed, and one is configured to MASTER to update the device(s) configured to SLAVE, connect the pins as shown in the Figure below.

Pin J (TX DATA) on the MASTER CM20 will connect to pin K (RX DATA) on the SLAVE device(s). Pin K (RX DATA) on the MASTER CM20 will connect to pin J (TX DATA) on the SLAVE device(s).
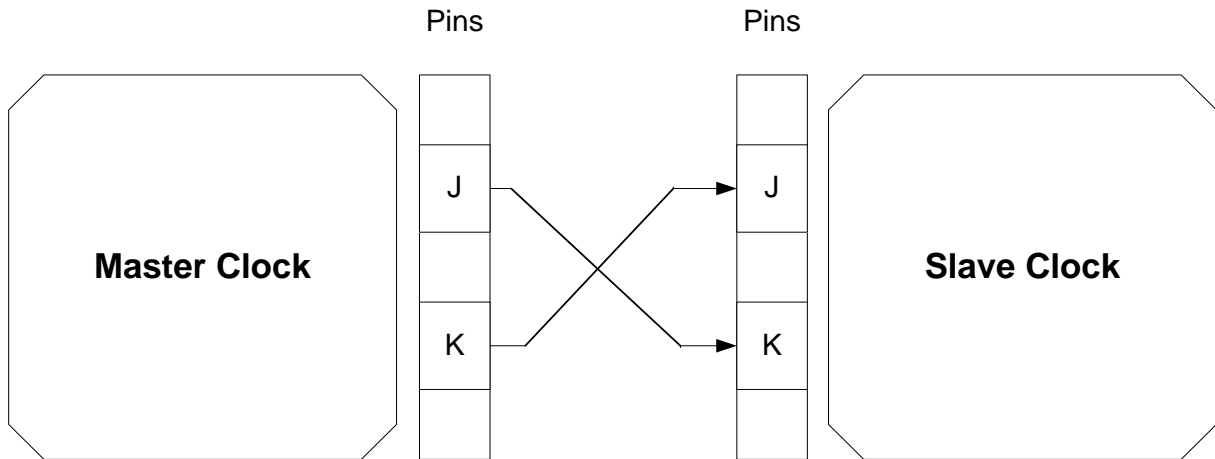

Figure 203 – Master-Slave Pin Assignments

1.5   Mounting Requirements

An ARINC mounting clamp (located behind the aircraft instrument panel) attaches the CM20 Digital Chronometer firmly to the hole in the instrument panel.
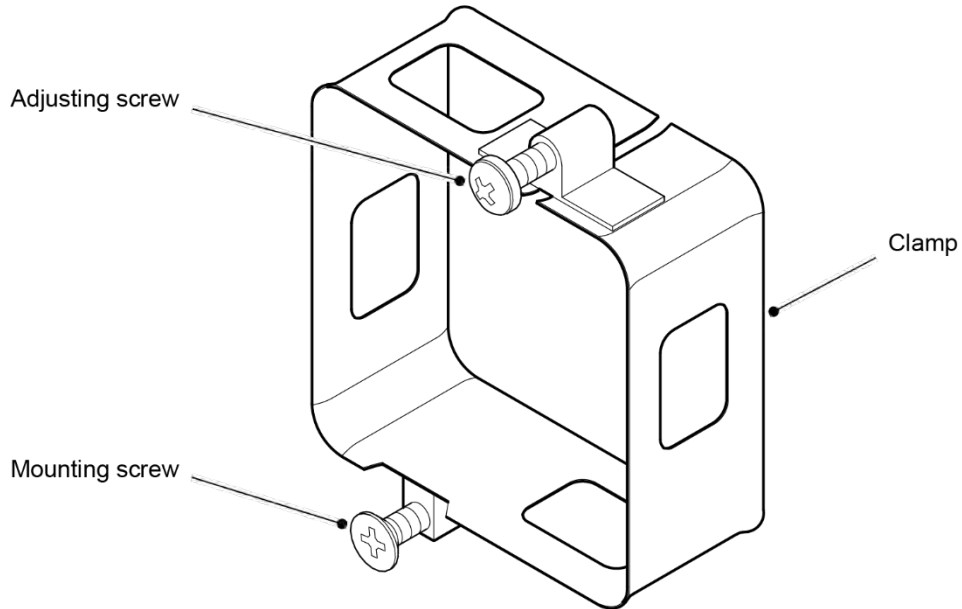

Figure 204 – ARINC Mounting Clamp

The Figure below shows the hole requirements in the aircraft instrument panel.
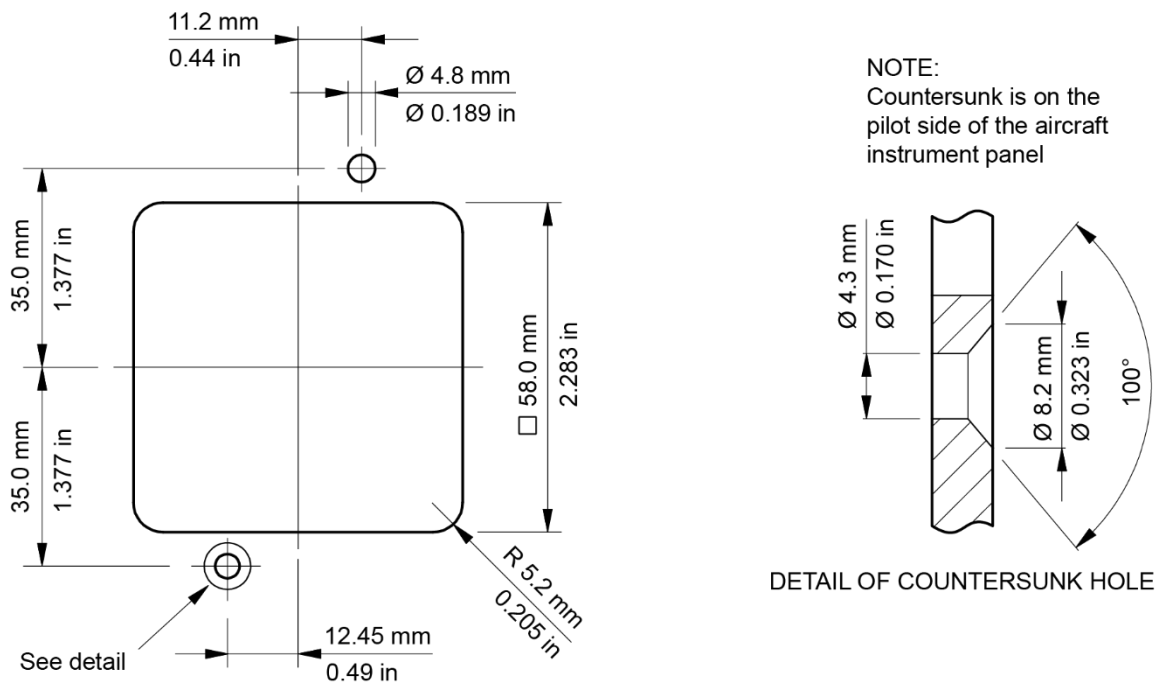

Figure 205 – Hole Dimensions in Aircraft Instrument Panel

1.6   ARINC Mounting Clamp Installation Procedure

The CM20 Digital Chronometer is mounted on the aircraft instrument panel using an ARINC mounting clamp as shown below:

Part Number	Description
35 296 001	ARINC Mounting Clamp

Before installing the CM20 Digital Chronometer, do the following procedure to install the ARINC mounting clamp to the aircraft instrument panel:

(1)   Set the aircraft electrical power to OFF (ref. AMM, Chapter 24).

(2)   Determine the installation position of the CM20 Digital Chronometer on the aircraft instrument panel (2) and make a new hole to the sizes given in Mounting Requirements (previous section).

(3)   Chamfer the inner and outer edges of the new hole and apply Alodine surface protection and black paint, as necessary. Let the paint dry.

(4)   Hold the clamp (1) behind the aircraft instrument panel (2).

(5)   Loosely install the upper adjusting screw (4).

(6)   Apply Loctite 243, then install and tighten the lower mounting screw (3).

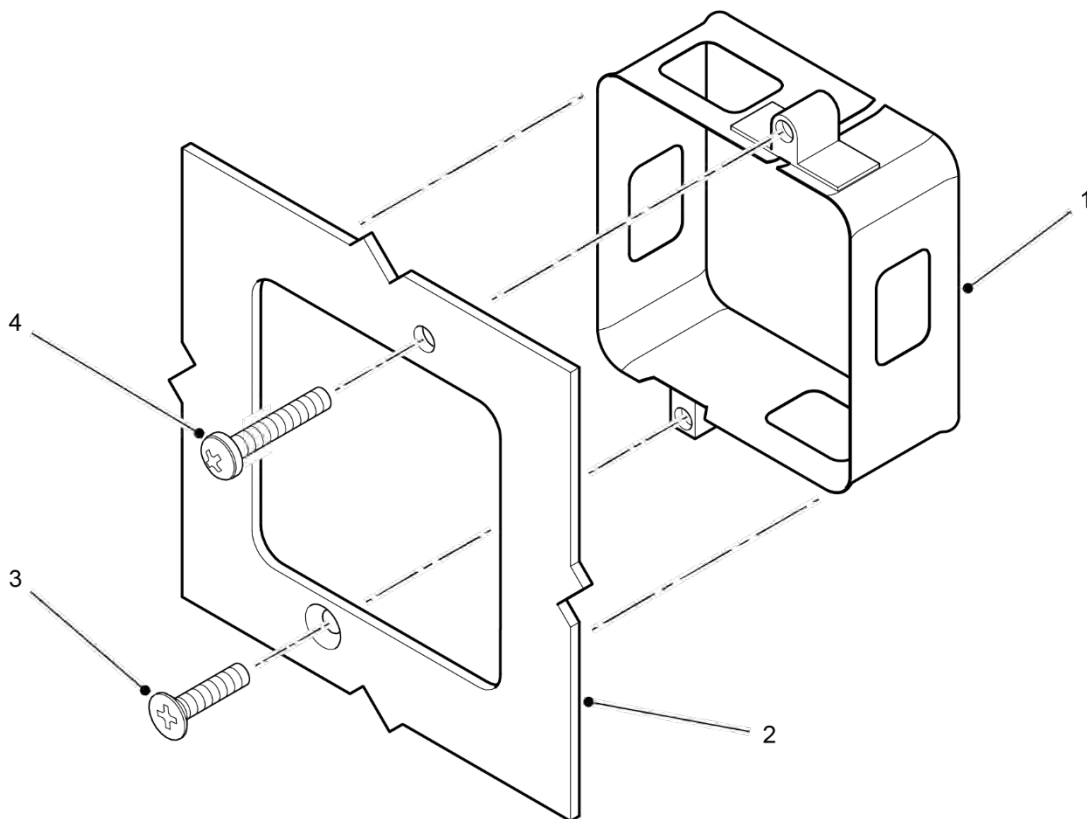(7)   Refer to Removal and Installation (page block 401) for installation of the CM20 Digital Chronometer.

Figure 206 – ARINC Mounting Clamp Installation

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1.7 Software Updates

Customers are not permitted to do any updates of the software for the CM20 Digital Chronometer. This task can only be done by Thommen Aircraft Equipment AG (or an approved service facility).

1.8 Electrical Bonding

The CM20 Digital Chronometer can be electrically bonded to the aircraft either from the back of the bezel, the housing, the mounting clamp or from the rear side of the CM20 using a bonding lead. The CM20 has a M5 threaded hole for this purpose on the rear of the housing. The depth of the threaded hole is 8mm.

The CM20 housing is not painted at the possible bonding surfaces to provide the appropriate conductivity.

If bonding is not done from the back of the bezel and/or the clamp, use a bonding lead and a M5 screw.

For bonding test procedure after installation, refer to Installation section, page block 401.
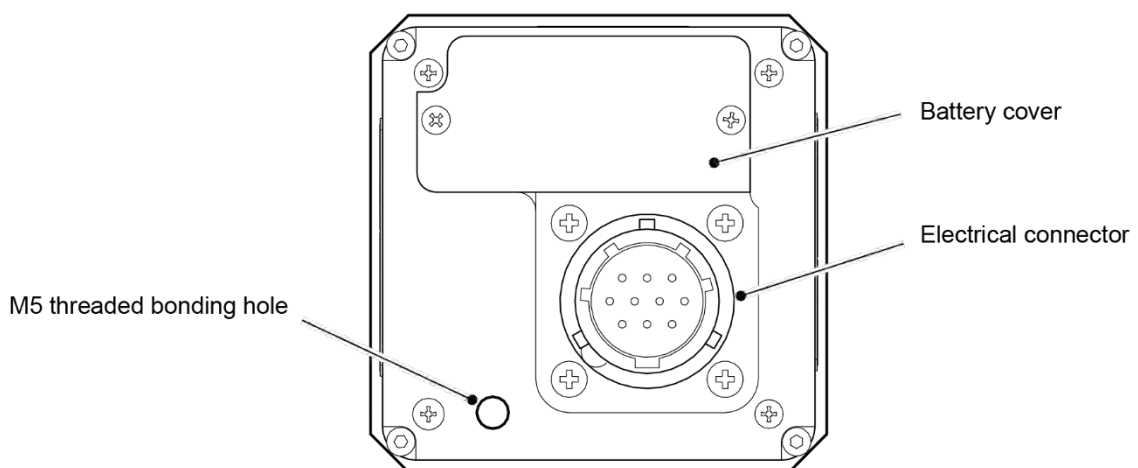

Figure 207 – Threaded Bonding Hole

1.9 Power Supply

The CM20 Digital Chronometer accepts a nominal supply power voltage of 14 VDC and 28 VDC for operation. The CM20 sinks 300 mA or less at a supply power voltage of 20 VDC or more.

A 3 volt battery (CR1225) (located behind the battery cover) supplies the CM20 with electrical power when aircraft power is set to OFF.

2.   Installation Features and Option Settings

2.1   DIP Switches

⚠️

CAUTION: DO NOT CHANGE THE POSITION OF THE DIP SWITCHES OTHERWISE THE
           CM20 DIGITAL CHRONMETER WILL NOT FUNCTION ACCORDING TO THE
           SPECIFICATION AND THE WARRANTY WILL BE INVALID.

The CM20 Digital Chronometer has a series of eight DIP switches, located behind the battery
cover, that are used to customize the electrical features and option settings of the device. These
are set by the manufacturer according to the specific requirements and must not be changed
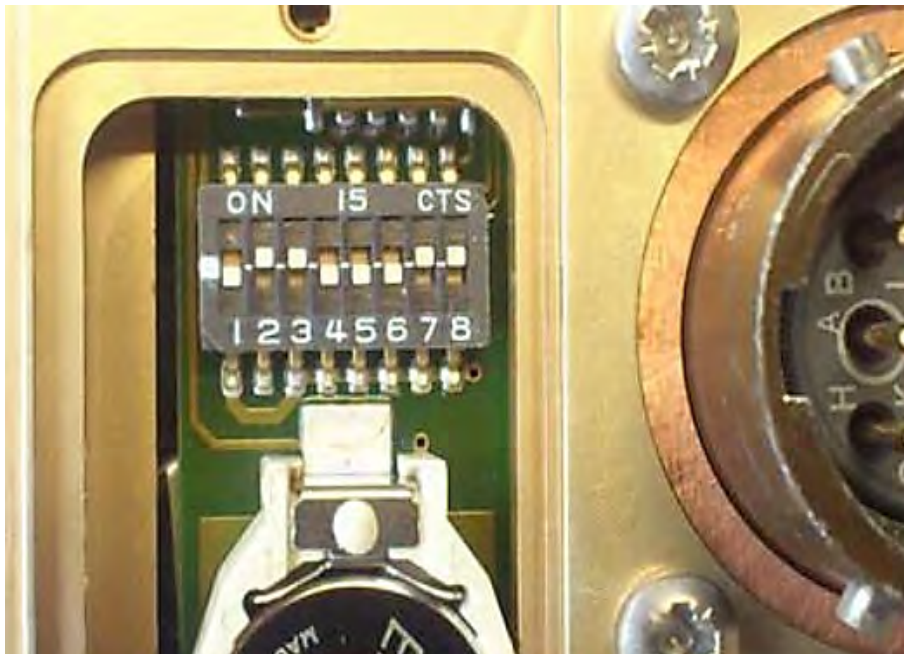by the customer.

Figure 208 – DIP Switches

2.2   Timer Start Switch Signal (Discrete Signal Input)

The flight timer can be activated by a discrete signal such as weight-on-wheels (WoW) to start counting. The flight timer can be configured to start counting in either an OPEN or CLOSED state, depending on the configuration of the DIP switches.

The activation level can be configured to ACTIVE HIGH and ACTIVE LOW. Depending on the setting, the definitions for OPEN and CLOSED status are different.

2.3   Active-High

The CM20 recognizes a resistance of 1 MΩ or more, or a voltage of 2 volts or less (measured from the timer start-switch signal input pin to the timer start-switch signal return pin) as OPEN status of the timer start switch signal.

The CM20 recognizes a voltage of 6 volts or more (measured from the timer start-switch signal input pin to the timer start-switch signal return pin) as CLOSED status of the timer start-switch signal.

2.4   Active-Low

The CM20 recognizes an external resistance of 1 MΩ or more, or a voltage of 6 volts or more (measured between the timer start-switch signal input pin and the timer start-switch signal return pin) as OPEN status of the timer start-switch signal.

The CM20 recognizes an external resistance of less than 100 Ohms or a voltage of less than 2 volts (measured from the timer start-switch signal input pin to the timer start-switch signal return pin) as CLOSED status of the timer start-switch signal.

2.5 Lighting Control Signal

The CM20 Digital Chronometer accepts the lighting control signal (LCS) in one of the formats defined in the following tables.

Lighting Control Signal (LCS) Format	Sinks Max.	Luminance Level Carried in
0-5 VDC	5 mA	Voltage level
0-5 VAC 400 Hz	5 mA	RMS voltage level
5 VDC PWM @ 400Hz to 9kHz	5 mA	Duty cycle

Table 202 – Lighting Control Signal 0-5 V

Lighting Control Signal (LCS) Format	Sinks Max.	Luminance Level Carried in
0-14 VDC	5 mA	Voltage level
0-14 VAC 400 Hz	5 mA	RMS voltage level
14 VDC PWM @ 400Hz to 9kHz	5 mA	Duty cycle

Table 203 – Lighting Control Signal 0-14 V

Lighting Control Signal (LCS) format	Sinks Max.	Luminance Level Carried in
0-28 VDC	5 mA	Voltage level
0-28 VAC 400 Hz	5 mA	RMS voltage level
28 VDC PWM @ 400Hz to 9kHz	5 mA	Duty cycle

Table 204 – Lighting Control Signal 0-28 V

The lighting control signal format is dependent on the configuration of the DIP switches.

2.6 Lighting Mode Switch (Discrete Signal Input)

The CM20 recognizes an external resistance of 1 MΩ or more or a voltage of 6 volts or more (measured from the lighting mode signal input pin to the lighting mode signal return pin) as OPEN status of the lighting mode signal.

The CM20 recognizes an external resistance of less than 100 Ω or a voltage of less than 2 volts (measured from the lighting mode signal input pin to the lighting mode signal return pin) as CLOSED status of the lighting mode signal.

2.7 Alarm

The alarm out signal enables the possibility of a visible or audible alarm to be installed in conjunction with the CM20 Digital Chronometer.

The CM20 recognizes a resistance of less than 100 Ω (measured between the alarm switch signal output pin and the alarm switch signal return pin) as CLOSED status of the alarm switch signal.

The CM20 alarm switch signal sinks up to 1A in the CLOSED status from the alarm switch signal output pin to the alarm switch signal return pin.

The CM20 recognizes a resistance of 1 MΩ or more (measured between the alarm switch signal output pin and the alarm switch signal return pin) as OPEN status of the alarm switch signal.

3.   Storage

3.1   Storage Facility Conditions

The CM20 Digital Chronometer must be stored according to the following environmental conditions:

- Temperature range: between +10°C and +30°C

- Humidity: 70% RH maximum

The building must comply with the storage facility requirements for lighting, ventilation, retention conditions, packing/unpacking, preservation materials (silica-gel sachets), storage shelves and fire hazard safety.

3.2   Handling, Transport and Storage

There is no hazard to personnel in handling, servicing or operating the CM20 Digital Chronometer.

The battery must be removed from the CM20 when it is put into long-term storage.

The CM20 Digital Chronometer is supplied in a storage box. This box is for long-term (more than 12 months) and short-term (less than 12 months) storage of the CM20, when it is not installed in an aircraft.

For long-term storage, small bags of activated silica-gel crystals should be put inside the storage box, around the CM20. The bags (sachets) of silica-gel crystals must be changed every 12 months (maximum).

4.   Battery Replacement

Do the following procedure to replace the battery (ref. Figure 209).

(1)   Get access to the rear of the CM20 Digital Chronometer (1) (if necessary, remove the CM20 from the aircraft instrument panel, ref. Removal, page block 401).

(2)   If necessary, disconnect the aircraft electrical connector from the electrical connector of the CM20 Digital Chronometer (2).

(3)   Remove the two screws (6), the battery cover assembly (4) and the battery (3).

(4)   Discard the battery (3) in an environmentally friendly way.

(5)   Install a new battery (3) (CR 1225). Be careful to observe the correct polarity of the battery.

(6)   Make sure that the gasket (5) is not damaged.

(7)   Carefully apply Loctite 243 to the two screws (6), then install the battery cover assembly (4). Make sure that the foam pad is firmly attached to the rear of the battery cover.

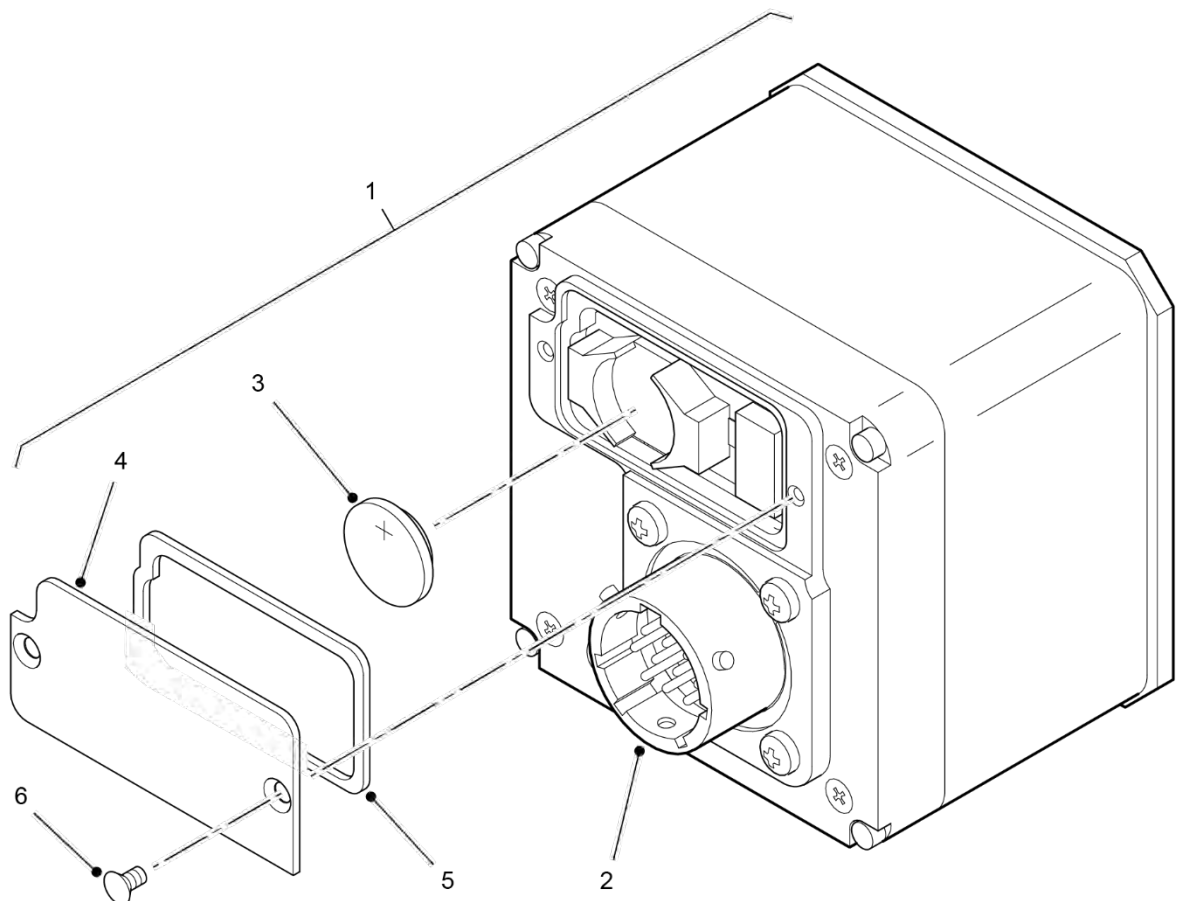(8)   Tighten the two screws (6) to the standard torque load.

Figure 209 – Battery Replacement

MAINTENANCE PRACTICES

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REMOVAL / INSTALLATION

1.   Removal

1.1   References

REFERENCE	ITEM
Aircraft Maintenance Manual (AMM)	Chapter 24, Electrical Power

1.2   Special Tools and Equipment

REFERENCE	ITEM
Local supply	Protective caps for electrical connectors

1.3   Consumable Materials

        None

1.4   Expendable Parts

        None

1.5   Preparation

        (1)   Make sure that the work area is clean and clear of unwanted parts and materials.

        (2)   Open and tag the applicable circuit breaker to disconnect electrical power to the CM20 Digital Chronometer (ref. AMM, Chapter 24).

1.6   Procedure

        Refer to Figure 401.

        (1)   Loosen the upper screw (pan head) (3) that holds the CM20 Digital Chronometer (1) in the clamp (5). Do not loosen the lower screw (countersunk head) (2).

                NOTE: The upper screw (pan head) (3) is for adjusting the tightness of the clamp (5) to the housing of the CM20 Digital Chronometer (1). The lower screw (countersunk head) (2) is for firmly attaching the clamp (5) to the aircraft instrument panel (4).

        (2)   Carefully pull the CM20 Digital Chronometer (1) from the aircraft instrument panel (4) to get access to the electrical connector (6).

        (3)   Disconnect the electrical connector (6) and remove the CM20 Digital Chronometer (1).

        (4)   Put protective caps on the electrical connectors of the aircraft and the CM20 Digital Chronometer (1).

1.7   Close-up

        (1)   Remove all tools and materials and clean the work area.
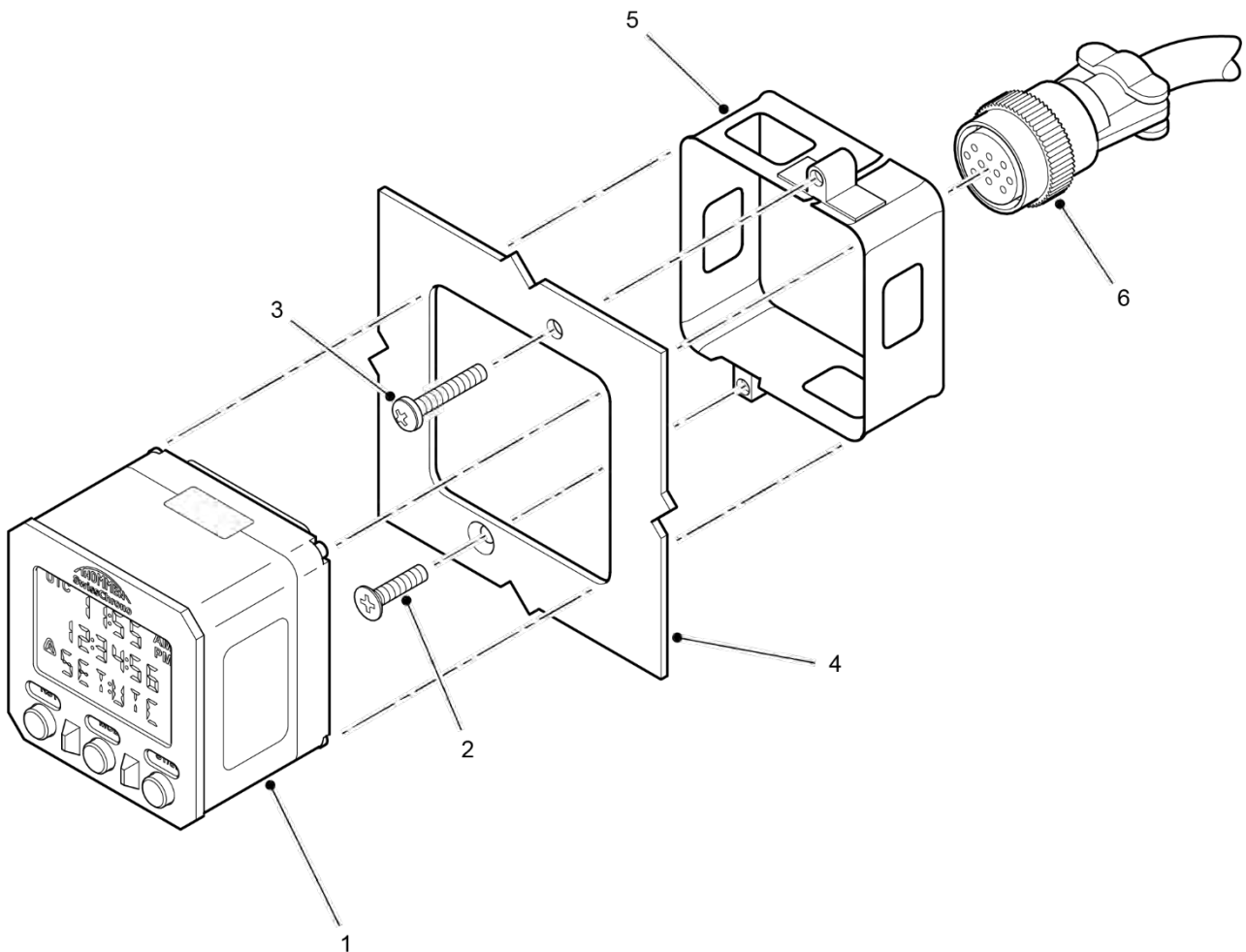
Figure 401 – CM20 Digital Chronometer Removal / Installation

2.   Installation

2.1   References

REFERENCE	ITEM
Aircraft Maintenance Manual (AMM)	Chapter 24, Electrical Power

2.2   Special Tools and Equipment

      None

2.3   Consumable Materials

      None

2.4   Expendable Parts

      None

2.5   Preparation

      Refer to Figure 401.

   (1)   If necessary, refer to ARINC Mounting Clamp Installation Procedure (Maintenance Practices, page block 201) for installation of the clamp (5).

   (2)   If necessary, refer to Electrical Connectors (Maintenance Practices, page block 201) for installation of the electrical connector (6).

   (3)   Make sure that the warranty-void label (located on the top of the housing) is undamaged.

   (4)   Make sure that the identification label and qualification label (located on the sides of the housing) are readable and undamaged.

   (5)   Do a visual check of the equipment. Do not install the CM20 if you find any mechanical damage (for example, cracks or scratches on the display).

   (6)   Make sure that the work area is clean and clear of unwanted parts and materials.

   (7)   Make sure that the applicable circuit breaker is open and tagged to disconnect electrical power to the CM20 Digital Chronometer (1) (ref. AMM, Chapter 24).

   (8)   Clean the inside surfaces of the clamp (5) and the mating surface of the housing of the CM20 Digital Chronometer (1) in accordance with the applicable aircraft procedures to ensure good electrical conductivity for grounding.

2.6 Procedure

Refer to Figure 401.

(1) If necessary, remove the protective caps from the electrical connectors of the aircraft and the CM20 Digital Chronometer (1).

(2) Make sure that the electrical connectors for the CM20 Digital Chronometer and the aircraft are clean and undamaged.

(3) Connect the CM20 Digital Chronometer (1) with the aircraft electrical connector (6).

(4) Carefully put the CM20 Digital Chronometer (1) in the clamp (5).

(5) Tighten the upper adjusting screw (3) on the clamp (5).

NOTE: The upper screw (pan head) (3) is for adjusting the tightness of the clamp (5) to the housing of the CM20 Digital Chronometer (1). The lower screw (countersunk head) (2) is for firmly attaching the clamp (5) to the aircraft instrument panel (4).

(6) Make sure that the lower screw (2) is tight.

2.7 Close-up

(1) Make sure that the conductivity resistance at the bezel back, body and mounting clamp is not more than 10 mΩ.

(2) Make sure that the electrical connector has 360 degree metal-to-metal contact with the housing of the CM20 Digital Chronometer.

(3) Make sure that the resistance between the electrical connector and the CM20 bonding interface is not more than 2.5 mΩ.

NOTE: Refer to Electrical Bonding (Maintenance Practices, page block 201) for details of bonding methods.

(4) Remove the tag and close the applicable circuit breaker for the CM20 Digital Chronometer (ref. AMM, Chapter 24).

(5) Do an Operational Test of the CM20 Digital Chronometer (ref. page block 501).

(6) Remove all tools and materials and clean the work area.

ADJUSTMENT / TEST

1.   General

This section gives the necessary procedures to evaluate the operational efficiency of the CM20 Digital Chronometer.

2.   Operational Test

An operational test is to make sure that the equipment fulfils its intended purpose. The task does not require quantitative tolerances. This is a fault finding task.

2.1   References

REFERENCE	ITEM
Aircraft Maintenance Manual (AMM)	Chapter 24, Electrical Power

2.2   Special Tools and Equipment

REFERENCE	ITEM
Local supply	NVIS goggles (only for NVIS light test)

2.3   Consumable Materials

None

2.4   Expendable Parts

None

2.5   Preparation

None

2.6   Procedure

(1)   If necessary, remove the safety tag and close the circuit breaker that applies electrical power to the CM20 Digital Chronometer (ref. AMM, Chapter 24).

(2)   Make sure the aircraft power is ON (ref. AMM, Chapter 24).

(3)   Make sure that the CM20 Digital Chronometer operates correctly by navigating through each of the functions.

(4)   Set the aircraft electrical power to OFF (ref. AMM, Chapter 24).

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INSPECTION / CHECK

1.   General

This section gives the information to do a visual inspection of the CM20 Digital Chronometer. Do the inspection before and after each flight.

2.   Inspection / Check

2.1   References

None

2.2   Special Tools and Equipment

REFERENCE	ITEM
Local Supply	Lint-free cloth
Local Supply	Isopropyl alcohol

2.3   Consumable Materials

None

2.4   Expendable Parts

None

2.5   Preparation

None

2.6   Procedure

(1)   Make sure that the CM20 Digital Chronometer is clean and undamaged.

(2)   If necessary, clean the CM20 Digital Chronometer with a lint-free cloth moistened with clean water.

(3)   If necessary, clean any grease or oil from the CM20 Digital Chronometer with a lint-free cloth and isopropyl alcohol.

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