

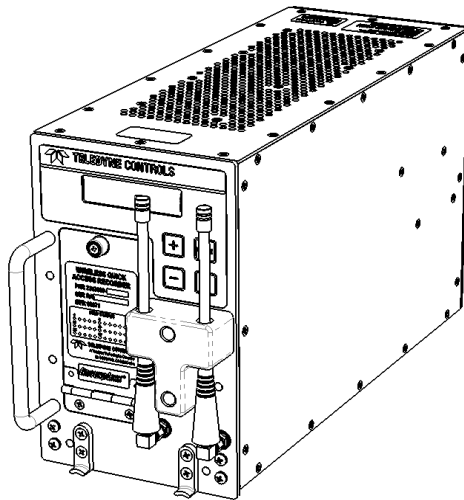
TELEDYNE CONTROLS **WQAR**

WIRELESS GROUNDLINK® - QUICK ACCESS RECORDER
PART NUMBER

2243800-360

2243800-362

2243800-364



USER'S GUIDE



501 Continental Blvd.
El Segundo, CA 90245 USA

UG2243800-300
Sep 16, 2013-Revised Nov 12, 2013

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US Federal Communication Commission (FCC) and Industry Canada (IC) User Notifications.

Interference (FCC part 15.19 / IC RSS-GEN ch. 7.1.3)

This device complies with FCC part 15 and Industry Canada license-exempt RSS standards. Operation is subject to the following two conditions:

1. *this device may not cause interference, and*
2. *this device must accept any interference, including interference that may cause undesired operation of the device.*

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

1. *l'appareil ne doit pas produire de brouillage, et*
2. *l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.*

Modifications

Changes or modifications made to this equipment not expressly approved by the manufacturer Teledyne Controls may void the FCC and IC authorization to operate this equipment.

RF Exposure

Radio Frequency (RF) radiation exposure Information:

This equipment complies with FCC and IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20 cm between its RF radiating structures and human

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bodies. Co-location of this transmitter (simultaneous transmission) with other transmitters shall be subject to maximum exposure re-evaluation.

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Definitions

3G	3 rd Generation Cellular Protocol
A/C	Aircraft
ACMS	Aircraft Condition Monitoring System
AMI	Airline Modifiable Items
ARINC	Aeronautical Radio Incorporated
DFDAU	Digital Flight Data Acquisition Unit
DOD	Download On Demand
eADL	enhanced Airborne Data Loader
FDIMU	Flight Data Interface Management Unit
OPC	Operation Program Configuration
OPS	Operation Program Software
QAR	Quick Access Recorder
RCD	Recording Completion Delay
RF	Radio Frequency
TMI	Teledyne Modifiable Items
UTC	Universal Time, Coordinated
WGCM	Wireless GroundLink® Ground Communication Manager
WPS	Words per Second
WQAR	Wireless GroundLink® -- Quick Access Recorder

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Section 1 - General

Introduction

The Teledyne Controls new Wireless GroundLink® Quick Access Recorder (WQAR), also known as the WQAR, is the latest addition to the QAR family of products (Figure 1). This compatible replacement for any QAR provides convenient access to airborne data by transmitting it over a high-speed cellular connection. It can receive flight data from any acquisition unit that is ARINC 717 compliant. The front panel display gives status while the buttons allow the operator to perform testing as well as view the configuration of the unit.

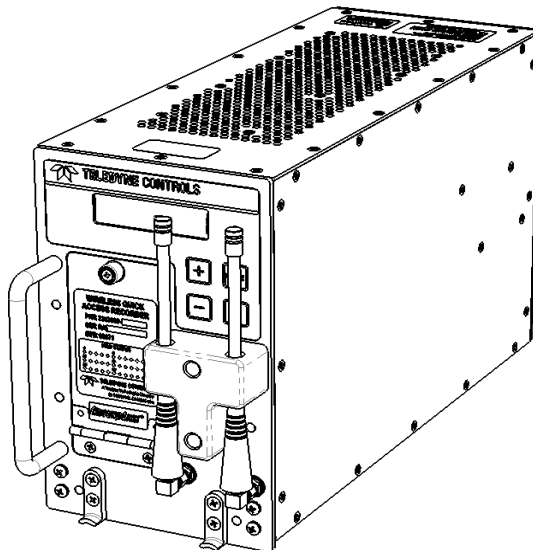


Figure 1 – Wireless GroundLink Quick Access Recorder (WQAR)

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Scope of this document

This user's guide describes the functions of the WQAR (P/N 2243800-36X) using the BOOT and OPS software (P/N 711745), version D. Sections in this guide include System Overview, Operations, Common Procedures, Fault Procedures, and other reference information.

The hardware variants in this WQAR family are listed below:

Part Number	Connector Type	Description
2243800-360	ARINC600	No Radios installed
2243800-362	ARINC600	Two radios with two antennae
2243800-364	ARINC600	Four radios with two antennae

For information on Teledyne Controls' WQAR (P/N 2243800-XX), refer to OG2243800.

WQAR Operation Overview

The primary purpose of the WQAR is to record and store flight data provided to it by a data acquisition unit such as a DFDAU or FDIMU. Then, while the aircraft is on the ground, it wirelessly transmits that data to a base station using high-speed 3G/4G cellular technology (where available). A backup copy of your data is stored on a removable Compact Flash (CF) card where it sits encrypted to ensure the safety of your data.

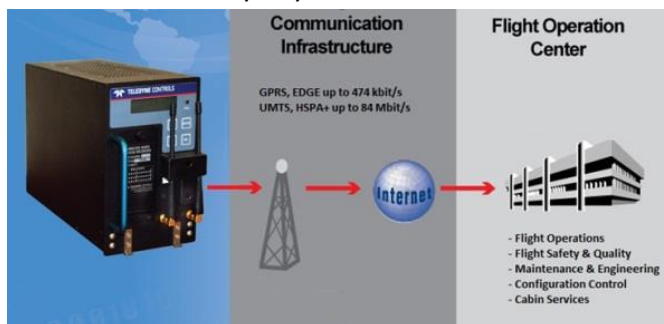


Figure 2 – Wireless GroundLink Communication Diagram

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Aircraft Signaling

The WQAR supports two different aircraft signaling types with their accompanying speeds:

- ❖ **BI-POLAR:** In addition to the standard hard-coded 64, 128, 256, 384, 512, 1024, and 2048 WPS rates, the WQAR supports AUTO mode where it dynamically determines the rate of the signal as it is coming in. It also supports a DISCRETE mode where, during bootup, it determines the speed by monitoring speed discretely activated from the acquisition unit.
- ❖ **BI-PHASE:** In addition to the standard hard-coded 64, 128, 256, 384, 512, 1024, and 2048 WPS rates, the WQAR supports AUTO mode where it dynamically determines the rate of the signal as it is coming in. It also supports a DISCRETE mode where, during boot up, it determines the speed by monitoring speed discretely activated from the acquisition unit.

If the WQAR is moved between multiple aircraft where both BI-PHASE and BI-POLAR are used alternatively, the signal mode can be put into DISCRETE mode where, during bootup, it monitors the BI-PHASE SELECT discrete. If this discrete is active, the WQAR will set itself to BI-PHASE. If this discrete is not active or not present in the aircraft, the WQAR will set itself to BI-POLAR. After determining the signal, it will determine the speed of the signal using the methods described above.

ACMS Reporting

In addition to the standard ARINC717 flight data, the WQAR can also record ARINC429 data (ACMS reports) if the acquisition unit sends such reports. When enabled, upon landing, the WQAR will power up the radios but wait a

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fixed amount of time before sending any data to allow for these reports to come in. This delay is referred to as the Recording Completion Delay (RCD) and can be set to any length. The typical setting is five minutes. Once the RCD has elapsed, the WQAR will send both the ARINC717 and ARINC429 data in a single file.

RF Interlocks

Aircraft regulations prohibit the WQAR radios from transmitting while the aircraft is in the air. To comply with this regulation, Teledyne Controls has incorporated hardware, referred to as RF Interlocks, which provides strict controls to allow power to be applied to the radios only while the aircraft is on the ground.

Mobile Networks

The WQAR transmits data utilizing the 3G/4G networks all over the world, including Korea and Japan, by dynamically determining the cellular frequencies wherever the aircraft is located.

The SIM cards used inside the WQAR are installed on a Removable SIM Module should the customer wish to use a different cellular provider.

Download on Demand (DOD)

While most customers prefer the WQAR to transmit data in their home network, during a flight emergency or other situation, they might find it necessary to transmit while the aircraft is outside their home network. Download on Demand enables the customer to direct the WQAR to override all restrictions and transmit during these situations. If that data is ever needed, customers can send a DOD command to the WQAR using their Base Station. As soon as the WQAR receives this message, all accumulated flight data will be sent back to the Base Station immediately.

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Run Control

Run Control is a feature in the WQAR that prevents extraneous or non-essential data from being recorded. Typically, the WQAR will record all data sent to it by the Acquisition Unit. However, some aircraft manufacturers (such as Airbus) or other Acquisition Unit manufacturers require the WQAR to record only when commanded by the Acquisition Unit. With the appropriate aircraft wiring in place, the Acquisition Unit can command the WQAR to record. This concept is called Run Control.

When this feature is enabled, the WQAR will show Run Control status on the front panel display (See Section 3). The WQAR can be set to one of three modes:

Run Control Mode	Description
0	Run Control Feature is not used. Flight Data is recorded at all times.
1	Run Control Feature is used. Flight Data is recorded when commanded by the Acquisition Unit.
2	Run Control Feature is used (Record in Air). Flight Data is recorded only when the RF Interlocks are engaged.

This mode is enabled by a setting in the configuration files (OPC).

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Section 2 – System Overview

Boot up and Pre-Flight Operations

Upon cold start, the WQAR FAIL light will blink slowly while it performs self-diagnostic tests. The FAIL light will blink quickly as the OPS software boots, determines the signal and speed of the incoming flight data, and adapts itself to the aircraft and cellular environment. During this time, the output FAIL discrete will not be set. After boot up is complete, the FAIL light will extinguish and the display will momentarily show STARTUP BIT COMPLETE followed by the normal SYSTEM STATE display as shown in Section 3 which indicates the WQAR is ready for operation. The boot up process takes approximately two minutes.

In-Flight Operations

Just prior to take-off, the WQAR will begin recording all incoming ARINC 717 and report data from the acquisition unit into internal memory. During flight, the data will be periodically compressed to ready it for transmission. An encrypted copy is also saved onto the removable CF card (P/N 2234641-008).

Post Flight Operations

Upon landing, the RF Interlocks will disengage and the radio(s) will power on and make contact with the Wireless Ground Communication Manager (WGCM). However, if the optional Recording Completion Delay (RCD) is enabled, flight data will not transmit until the RCD has expired (See Section 1, ACMS Reporting, for details). During this delay, the WQAR will continue to receive final airborne data and ACMS reports (if present) and insert that into the compressed file for that flight and close the file. If the WQAR determines that it is permitted to transmit at the current destination, it will send the flight data to the WGCM. If not, at the next destination, it will make the determination again. It will continue to do all of the above at every

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destination until the aircraft arrives in a permitted cellular network where it will transmit all accumulated data. If a transmission is interrupted for any reason, the WQAR does not need to re-transmit from the beginning. It has the ability to resume from the point of interruption. The radios will remain powered on while the aircraft is on the ground whether transmissions occur or not. If the Download on Demand (DOD) feature is enabled, the WQAR will accept any DOD messages if they are sent. See Section I for an overview on this feature. Contact Teledyne Controls Customer Services for more information.

If the cellular radios cannot transmit for any reason, data can still be retrieved by ejecting the compact flash (CF) card using the procedure in Section 4. See Section 5 for specific details.

Upgrading and Configuring Your WQAR

Only the aircraft tail number can be changed via the front panel buttons. However, the Radios can be disabled and the Run Control mode can be overridden via the front panel. These changes will persist through power cycling.

In general, there are two software components in the WQAR: The OPS (software) and OPC files (configuration files). The OPS and OPC files are ARINC 665 Loadable Software Parts (LSPs).

The OPS, which runs on the WQAR, can be upgraded using the procedures found in Service Bulletins provided by Teledyne Controls. Contact Teledyne Controls Customer Services for details.

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The OPC LSPs, which contain parameters, configure the WQAR to adapt it to your aircraft and cellular environment. These LSPs, customized for each operator, are installed in every WQAR at the factory and are listed below.

LSP	Description	Customer Modifiable
All	Aircraft Interface Items	No
AMI	Airline Modifiable Items	Yes
TMI	Teledyne Modifiable Items	No
Switch	Switch Configuration Items	No

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Section 3 – WQAR Operations

Front Panel

The WQAR has a front panel interface to allow the operator to check status as well as perform diagnostics and other maintenance activity (Figure 3).

Antennae have been removed for clarity in Figure 3.

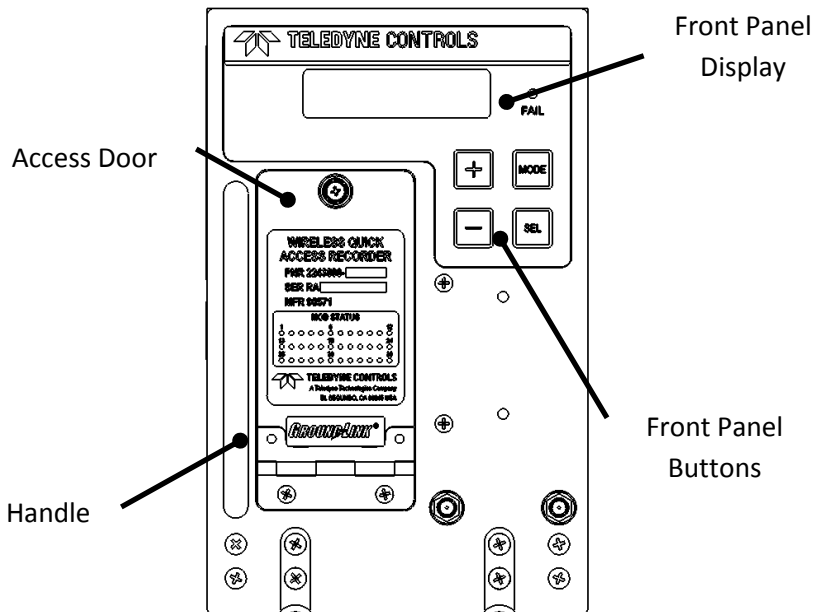


Figure 3 – WQAR Front Panel

Front Panel Display

The blue backlit front panel display has two lines with 16 characters each and shows the status of the unit. The top line displays the general status of the unit including failure status. Figures 4 and 5 shows normal post-boot-up

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status for Run-Control enabled aircraft (usually Airbus) and Non-Run-Control enabled aircraft (usually Boeing and others).

RUN DISABLED

R_On : :Ioff

Figure 4 – WQAR Display (Run Control Enabled)

R_On : :Ioff

Figure 5 – WQAR Display (Non-Run Control Enabled)

RawIn:NoSync

R_On : :Ioff

Figure 6 – WQAR Display (Data out of Sync)

RawIn:SyncIn:Msg

R_On : :Ioff

Figure 7 – WQAR Display (Data In Sync)

Figures 6 and 7 show an example of the display when flight data is coming in when it is out-of-sync and in-sync respectively. In addition, Figure 7 indicates that the WQAR has recorded ACMS report(s) by displaying “Msg”.

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The bottom line has three sections separated by colons (:) which indicate the status of hardware inside the WQAR:

- ❖ **Left Section:** Monitors the status of the cellular radios by displaying whether power is applied to the radios and the connection status.
 - **R_On:** Radio(s) are powered on. This is the default state while the aircraft is on the ground.
 - **R_Off:** Radio(s) are powered off.
 - **CON:** Connected. The WQAR has achieved a connection with the WGCM. “**NO_CON**” may be displayed if a connection attempt fails.
 - **DN:** Downloading. The WQAR is currently downloading data to the base station.
 - **UP:** Uploading. The WQAR is currently uploading data from the base station.
- ❖ **Middle Section:** Monitors the status of the airborne data files such as whether the files are ready for transmission.
 - **RDY:** Ready. The WQAR has met the minimum raw data requirements to transmit data.
 - **RCD:** Recording Completion Delay. The WQAR is waiting for any final data from the acquisition unit before performing final compression and closing of the data file.
 - **CMP:** Compression. The WQAR is actively compressing data at this time.
 - **<Blank>:** The WQAR is not in any of the above states.
- ❖ **Right Section:** Monitors the status of the RF Interlocks. A discussion of the RF interlocks is in Section 1. In Figures 4 and 5, the RF Interlocks are shown to be off.

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- **Ion:** Interlocks are engaged. The radios are restricted from receiving power.
- **Ioff:** Interlocks are not engaged. The radios are no longer restricted from receiving power.

FAIL Indicator

The WQAR is equipped with an amber-colored FAIL indicator which will illuminate whenever a hardware fault is detected, configuration files are missing, or if the internal flight data card is full. The FAIL discrete will usually (but not always) be activated whenever the FAIL indicator is illuminated.

Front Panel Buttons

There are four buttons on the front panel:

Button	Description
	This button is used to exit out of the current menu or to escape certain functions in process.
	The SELECT button is used to enter into the selected menu. It is also used to choose or confirm any changes made to the LRU.
	The + (PLUS) button is used to advance though the various menus and parameters.
	The – (MINUS) button is used to reverse though the various menus and parameters.

Access Door

The outside of the access door has the label which displays the Part Number, Serial Number, and MOD Status. The door, which swings down, can be opened by rotating the thumbscrew counter-clockwise. Behind the door are the Removable SIM Module (RSM), the Compact Flash (CF) Recording Media, the RJ-45 port, and the RS-232 Console Port. The CF Recording Media (P/N

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2234641-008) contains encrypted backup flight data and system log file. The Removable SIM Module can hold up to four SIM cards, one for each of the four cellular radios inside the LRU. Maintenance procedures for the Removable SIM Module and CF cards are in Section 4.

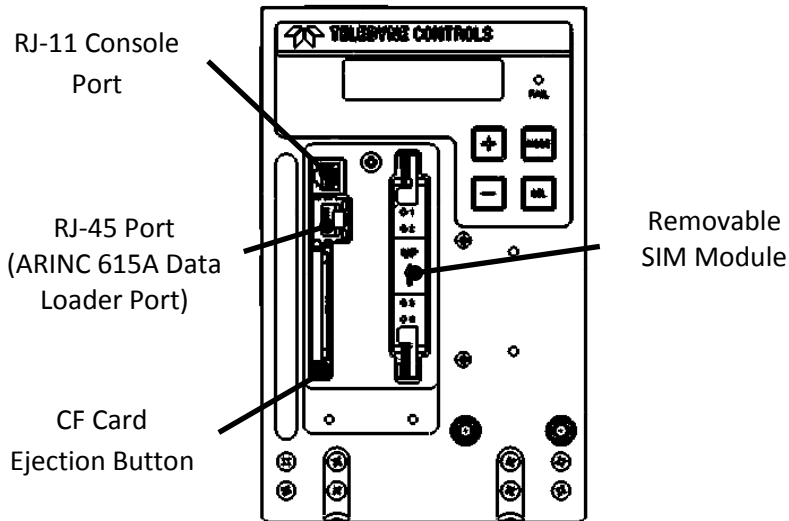


Figure 8 – Behind the Access Door

Antennae

There are two antennae connected to elbow connectors at the front of the unit and are secured in place with a bumper to discourage handling. They can be replaced using the appropriate procedure. Contact Teledyne Controls Sales Department for replacement parts. The antenna replacement procedure will be in a Service Bulletin.

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Date/Time

The WQAR has a system clock (UTC) and is set at the factory using the front panel System Menus. The clock's power source is a super-capacitor inside the WQAR which lasts approximately 30 days. The clock will lose its time if it doesn't have access to aircraft power for that length of time. The WQAR does not use the Captain's clock to refresh the clock. However, if configured, the WQAR will update the clock whenever it connects to the Wireless Groundlink Communication Manager. This time update takes up to approximately five minutes and the FAIL light will blink during this time and the unit will reboot. After reboot, the WQAR will be operational with the proper time.

System Menus

The WQAR menus are accessed using the Front Panel Buttons and are viewed in the Front Panel Display. After bootup, the unit defaults to the SYSTEM STATE menu which displays the system status as shown in Figures 4 and 5. If the WQAR buttons experience no activity for 30 minutes for top-level menus and 10 minutes for sub-menus, the WQAR automatically returns to this menu.

Entering and Exiting Menus

To exit any menu, including the SYSTEM STATE menu, press the MODE button. To enter any menu, including the SYSTEM STATE menu, press the SEL button. After viewing any menu, it is always good practice to return to the SYSTEM STATE menu.

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