Technical Note

PendoTECH PressureMAT™ : Yokogawa Integration

1. Introduction

The PendoTECH PressureMAT pressure monitor and transmitter (PMAT) and PMAT plus are used to read inputs from an assortment of PendoTECH Sensors. To use a PMAT for GMP data collection PendoTECH recommends integration with a Yokogawa paperless chart recorder. Yokogawa data acquisitions systems recommended by PendoTECH come equipped with the advanced security option which supports the USA FDA's Title 21CFR Part 11 regulation. This enables PMAT users to acquire GMP compliant data from PendoTECH PMAT monitors and single use sensors. The advanced security option includes access to a login function which requires user names, IDs, and passwords, plus electronic signatures, audit trails, an anti-tampering function, and other security features. The following technical note describes how to integrate a PMAT with a Yokogawa Paperless recorder.

Disclaimer: This note is not meant to describe all the features of the Yokogawa digital recorder, rather as a guide to connect a PMAT and begin collecting data. Refer to section 8 for further documentation.

2. Ordering Information

- **Yokogawa**

The GP10/GP20 are portable type paperless recorders that display real-time measured data on a touchscreen and save data on an external storage medium (SD card). The GP10 model can accommodate up to 30 input signals while the GP20 can accommodate up to 100 inputs. PendoTECH recommends the GP10 model due to its small size and user configurability.

When ordering the Yokogawa, it is important to choose the proper options in order to make integrating with a PMAT as easy as possible. The following information lists the part numbers that PendoTECH recommends. For a full list of options please refer to vendor documentation.

Model	Suffix Code				Optional Code	Description
GP10 [1]						Paperless recorder, small display (recommended)
GP20 [1]						Paperless recorder, large display
Type	-1					Standard
Display Language		E				English, degF, DST (summer/winter time)
Power Supply			1			100 V AC, 240 V AC
Power Cord [2]				D		Power cord UL/CSA standard
				F		Power cord VDE standard
				R		Power cord AS standard
				Q		Power cord BS standard
				H		Power cord GB standard
				N		Power cord NBR standard
Optional Features [3]					/AS	Advanced security function (Part 11)
					/MT	Mathematical function (with report function)
					/UH	USB interface (Host 2 Ports)
					/E1	EtherNet/IP Communication
Analog Inputs [4]					/US10	With analog input module, 10 ch (M3 screw terminal)
					/US20	With analog input module, 20 ch (M3 screw terminal)
					/US30	With analog input module, 30 ch (M3 screw terminal)

1: Choose either GP10 or GP20. PendoTECH recommends GP10
2: Choose one depending on local power supplies
3: /AS, /MT, and /UH are recommended. /E1 is listed to support specific user needs.
4: Choose only one depending on number of channels needed. Additional channels can be added at any time.

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The nominal accuracy specs for Yokogawa paperless chart recorders are listed below.

Input Type		Measuring Accuracy
DCV	20 mV	$\pm$ (0.01% of reading + 5 µV)

Example: The PendoTECH recommended unit would be specified as: **GP10-1E1D/AS/MT/UH/US10**

- **PMAT (or PMAT Plus)**

Each input channel on a PMAT or PMAT plus has an accompanying output channel. These output channels can be specified as either an analog output (4-20 mA signal) or as a relay signal (contact closure). This option is specified when placing an order for either a PMAT or PMAT plus. In order to send the readings from a PMAT to a Yokogawa recorder the output channels must be specified as an analog output for each channel that you want to transmit to the data logger.

3. Connecting PMAT

The Yokogawa GP10 (or GP20) will be separate from the analog input module when received. The analog input module must be installed before any signal can be sent to the unit.

1. Remove panel cover on rear of unit. Panel is held in place by a screw on the bottom of the cover and clips on top.


2. Remove cover on analog input module to access screw terminals. Cover is held in place by a screen on the bottom and clips on top. The cover can be replaced once all connections have been made with PMAT.

3. Install analog input module into slot 0 (indicated on top of unit). The input module should click into place and is secured with a screw on the bottom of the module. The yellow tab on the bottom of the module is the release lever which is used when uninstalling the module.

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A PMAT, or PMAT Plus, can have up to 4 input channels each with an accompanying output channel. Each output channel will be wired to the Yokogawa paperless chart recorder with a 1:1 to ratio. For example, a PMAT4 has 4 pressure inputs and 4 analog outputs. The 4 analog outputs will be wired to channels 1-4 on the Yokogawa analog input module. The total number of channels that a Yokogawa has is determined by the selections made when ordering (refer to section 2).

The PMAT analog outputs can be found along the bottom of the unit's back panel as shown below.
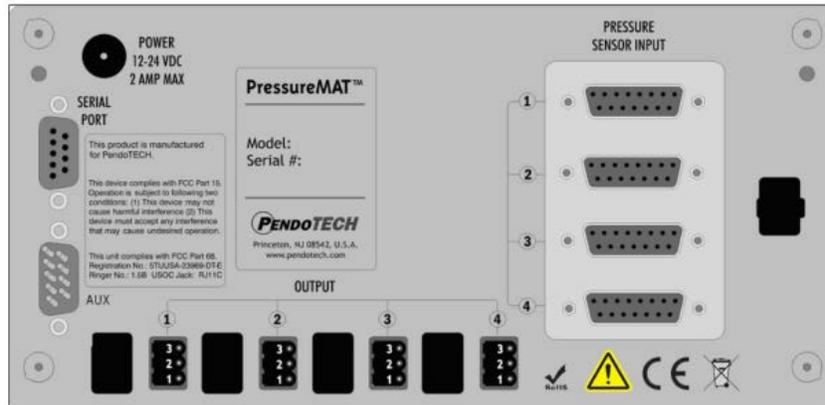
Please inform PendoTECH, at the time of purchase, if the PMAT is to be used in conjunction with a Yokogawa paperless chart recorder. A set of custom cables, that have a 3-pin connector on one side and un-terminated leads on the other, will be included with the order. The 3-pin connector fits directly into the PMAT analog output channels, pictured above, and the leads will be wired to the Yokogawa screw terminals.

If retrofitting an existing PMAT unit, the connection cables can either be purchased from PendoTECH (Part# PMAT-AL) or wired per the PMAT user guide using the supplied screw terminals. If purchasing cables, please note that one cable is needed for each channel that is being connected to the Yokogawa. The configuration for the wiring is shown below.

Pin #	Signal
1	Output 4-20 mA signal (+)
2	N/A
3	Common (ground)
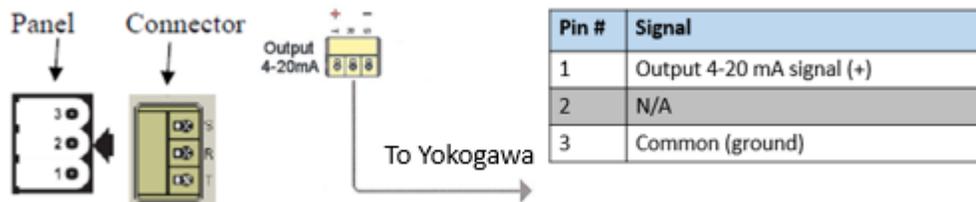
The wiring for the two leads on the signal cable to the Yokogawa are shown below.
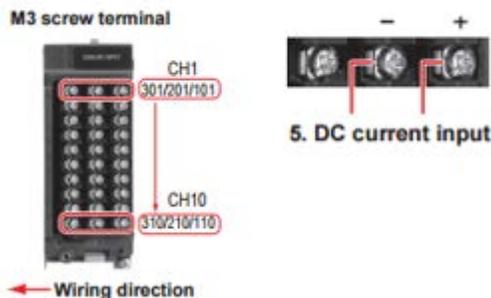
For each channel that is being used on the analog input module, the leads from the PMAT should be wired from right to left with the output signal being connected to the "10X" terminal and the common pin

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connected to the "20X" terminal where X is the number of the channel read from top to bottom. Once all channels have been wired the Yokogawa unit will be able to receive signals from the PMAT.

4. Setting up a Channel

Connect power cord to Yokogawa unit and plug into power supply. Pull open the front door on the Yokogawa door to access the unit's power button. The Yokogawa unit will come with a SD card, insert card into slot located in front hatch of unit. Turn the unit on then close the front door. A self-test will occur for a few seconds, then the operation screen appears. Follow all paths referenced below by tapping on the screen with the stylus provided with the Yokogawa unit.

Note: If installing analog input modules, the system must be reconfigured after install.
- Path: **Menu >** Tap **Browse** tab > **Initialize Calibration > Reconfiguration > Execute**
  - o After pressing execute the system information will appear.
- Tap **Reconfigure**
- Tap **OK**

4.1 Set the date and time:
1. Set time zone and DST (daylight savings time).
   - Path: **MENU key >** **Browse** tab > **Setting** > Setting Menu **> System Settings > Time basic settings.**
   - Note: The time zone setting is the difference between time zone where recorder is being used and Greenwich Mean Time (GMT).
2. Set Date and Time
   - Path: **Menu key > Universal** tab > **Date/Time settings**
     1. Tap the date tab
     2. Set the month and day with the switch icons
     3. Tap the time tab
     4. Enter the time using the keyboard then press **OK.**

4.2 Configure Input Channels
1. For channel 1 (0001) of slot 0
   - Path: **MENU key >** **Browse** tab > **Setting >** Setting menu > **AI Channel Settings > Range**
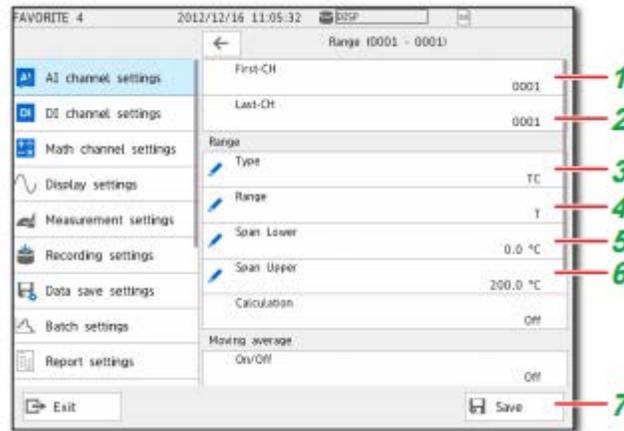
1. Tap **First-CH > 0001**
2. Check that Last-CH is 0001
3. Tap **Type > GS (4-20 mA)**
4. Tap **Scale Lower**, and enter 4 mA value from table below
5. Tap **Scale Upper**, and enter 20 mA value from table below
6. Tap **Unit,** and enter units of measurement for channel, i.e. PSI, bar, or mbar for pressure.
7. Tap **Save.**

PMAT: Various Models Default Analog Output Spans				
	PMATs (PSI)	PMATs (bar)	High Resolution (PSI)	High Resolution (mbar)
Low Units (4mA)	-10	-0.69	-1	-69
High Units (20mA)	75	5.17	3	207

2. Repeat steps for each channel that is being utilized. Ensure that the scale options are set to equal the range of the input sensor per the table above.
3. Configured channels are displayed on the main screen in groups. Add channels to your desired group by accessing the "Group settings menu".
   - Path: **MENU key > Browse** tab > **Setting** > Setting menu > **Display Settings > Group Settings**
     1. Tap **Group Number**.
        - Groups are numbered 1-30 and can contain anywhere from 1-10 channels per group.
     2. Set **Group Settings**
        - Tap **On/Off** then select **On** to turn group on.
        - Tap **Group Name**. Use the keyboard to enter the name of the group, i.e. pressures, TFF, Purification, etc.
        - Tap **Channel Set.** A dialogue box will open that allows configured channels (see section 4.1) to be added to the group. Tap all channels that you wish to be displayed as part of the group.
     3. Channels will now be displayed on the **Trend, Digital, and Bar** screens. You can switch between groups by pressing the **Menu** button at any time and using the arrows to move between various groups.
   - **Note: Channels will not be displayed visually unless they are added to a group.**

5. Setting Access Levels

As described in section 1, Yokogawa data acquisitions systems recommended by PendoTECH come equipped with the advanced security option which supports the USA FDA's Title 21CFR Part 11 regulation. This section will describe how to setup user names, passwords, and access levels for various operators. A Yokogawa Data Recording and storage flowchart can be found in the appendix.

For a full description of all features of the advanced security package, including date storage and audit trail information, refer to "Model GX10/GX20/GP10/GP20 Advanced Security Function (/AS) User's Manual. There are three user levels available: Administrator, User, and Monitor User, and up 100 users can be registered at a single time. The user levels and descriptions are listed below.

User Level		Description
Administrator	Admin	An administrator has access to all operations.
User	User	A user cannot access security settings. Nor can a user perform A/D calibration, enable the advanced security function, configure the encryption function or create keys for encryption/certificate, or upload I/O module firmware. You cannot set the multi batch function on or off or load settings that include the multi batch function on/off setting. You can specify the range of operations that a user can perform.
Monitor user	Monitor	A monitor user can only use the monitor function. The user cannot configure or operate the GX/GP.

5.1 Configuring the Security Function, Logout, Password Management Function, etc.
1. Enable advanced security feautre
   - Path: **Menu** key > **Browse** tab > **Init/Calib >** Setting Menu **Advanced security settings**
     1. Menu will allow you to enable advanced security features and set a password to prevent settings from being changes.

       2. Tap **Execute.** A confirmation screen will appear. Selecting **OK** will save the changes and the unit will restart.

2. Configure that security settings to best fit the needs of your facilitiy. These can be changed in the Security settings.

- Path: **Menu** key > **Browse** tab > **Setting >** Setting Menu **Security Settings** > Basic Settings
    1. Set security for touch operation and communication to other computers or via ethernet.
    2. Other security features in this menu include auto logout, password management, password retry.
    3. Ensure User ID is turned on to allow for creation of user IDs and access levels.

5.2 Registering Users

1. Register users. Note: The user level of user number 1 is fixed to admin.

- Path: **Menu** key > **Browse** tab > **Setting** > Setting Menu **Security Settings > User Settings**
    1. Select the user number to register.
    2. Enter information for the following categories

Setup Item	Selectable Range or Options	Default Value
User level	Off/Admin/User/Monitor	Off
Mode	Touch operation, Communication, Touch operation + Communication	Touch operation + Communication
User name	Character string (between 1 to 20 characters, [A][a][#][1])	—
User ID*5	Character string (up to 20 characters, [A][a][#][1])	—
Initialize password	Back, Initialize password	—
Password expiration*2	Off, 1 month, 3 month, 6 month	Off
User property*1	Off/On	Off
Authority number*3	1 to 10	1
Sign in property*1	Off/On	Off
Authority of sign in*4	1 to 8	1

*1 Appears when the user level is set to User.
*2 Does not appear when the user level is set to Monitor.
*3 Appears when the User property is set to On.
*4 Appears when the Sign in property is set to On.
*5 Does not appear when the user ID is disabled.

2. Repeat until all necessary users have been registered in the system.

6. Logging/Trending Data

Once the Yokogawa unit has been configured with security features and access levels turned on. The system can be used to collect GMP compliant data. Please refer to the appendix for a list of data types that can be recorder by the unit.

6.1 Data Collection

1. Begin Data Collection

- Path: Press **Menu** key. The following screen will appear
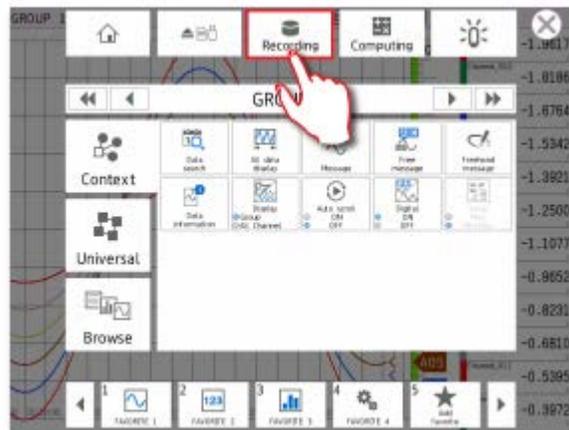
- Tap the **Recording** icon. The record start screen will appear.

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- Tap **Record.** Recording will begin. The recording status icon in the status display section changes to recording in progress.
- You can also start recording by pressing the **START/STOP** key on the front of the unit.

## 6.2 Trend Data and other Operator Screens.

1. Being recording data as described in section 6.1.
2. Press **Menu** key. The following screen appears.
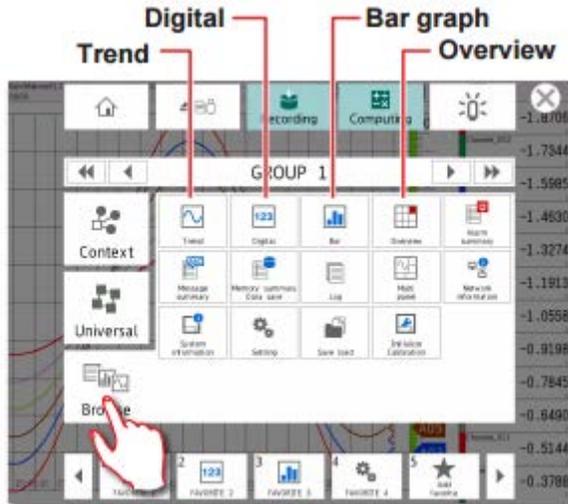
3. Tap the **Browse** tab.
4. Tap the icon of the display that you want to change to.

7. Data Storage

When the record button is pressed all data will be written to the Yokogawa internal memory. The recording will be assigned an identifier consisting of the time and date when the recording was started. Measured and calcuated data is continuously saved to secure, internal non-volatile memory. At manual, or scheduled intervals, the files in memory are copied to the removable media (SD card).
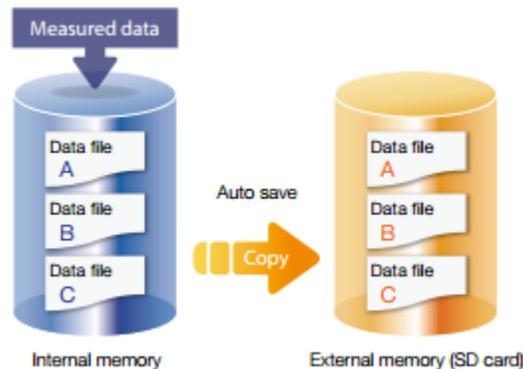
The measured data is partitioned and saved at set intervals. If the internal memory is full or if the number of display data files and event data files exceeds 500 for GP10, files are overwritten from the oldest file.

Data can also be selectively exported to a USB drive. The data can not be edited at any time and can only be opened on a laptop that has the Yokogawa Universal Viewer software installed. This is available for free download with purchase of a Yokogawa recording device.

7.1 Exporting Data to USB

1. Insert USB Memory stick. The media operation screen automatically appears.
2. Tap the **Memory save Data** icon. The memory/summary screen appears.

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3. A list of all recording sessions written to the internal SD card will appear on the screen. Check the boxes for the sessions that are to be saved to the USB memory stick.
4. Press **Menu.**
5. Tap the **Context** tab. Each data save icon appears.
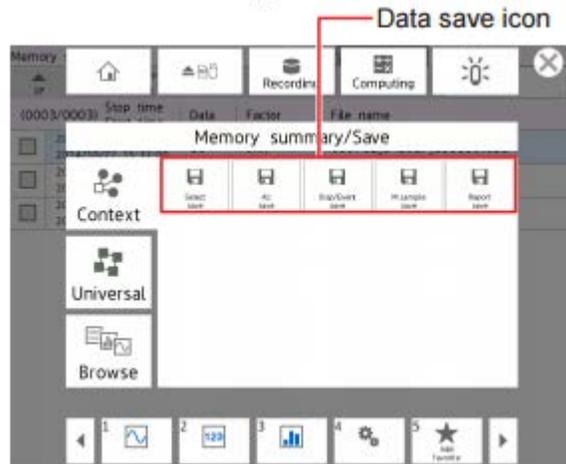
6. Tap appropriate save function (Select Save, Save all, etc) then the data save screen will appear.
7. Select the **USB**, and tap **OK.** The data is saved to USB memory.
   a. The file will be saved as a .GSE file that which can be viewed and printed using Universal viewer. The software allows users to perform starisical computation over an area and export to ASCII, Excel, and other formats.

8. Additional Resources

PendoTECH offers a PressureMAT IQ/OQ package. Contact PendoTECH for further details, reference part # PMAT-IQOQ.

This technical note describes the manner in which to connect a PMAT to a Yokogawa paperless chart recorder. It does not cover operation of either unit in great detail. The following resources can be used to troubeshoot and explore the more advanced features of the equipment. The manuals listed below can be easily found on either the PendoTECH or Yokogawa web pages.
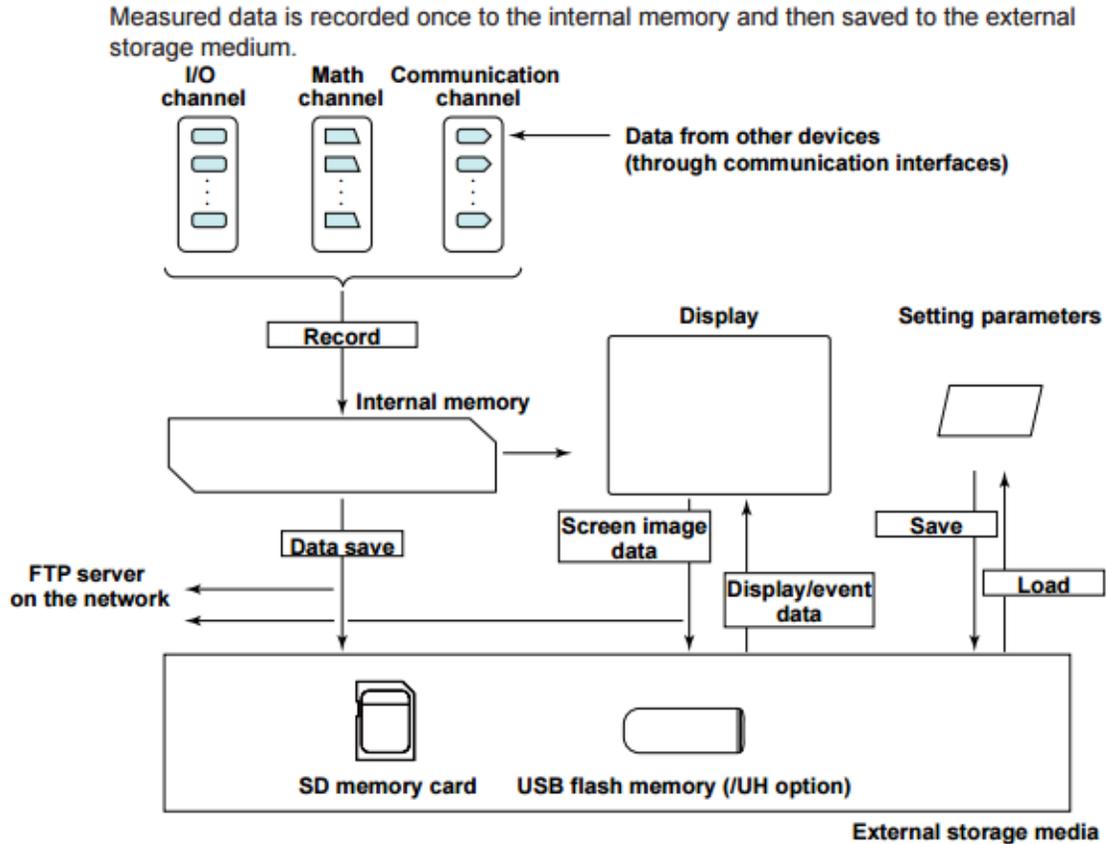
- www.pendotech.com
- www.smartdacplus.com/manual/en/

| Manual Title	Manual #
PressureMAT System User Guide	N/A
Model GX10/GX20/GP10/GP20 Paperless Recorder First Step Guide	IM 04L51B01-02EN
Model GX10/GX20/GP10/GP20 Paperless Recorder User's Manual	IM 04L51B01-01EN
Model GX10/GX20/GP10/GP20 Advanced Security Function (/AS) User's Manual	IM 04L51B01-05EN
Model GX10/GX20/GP10/GP20 Ethernet/IP Communication (/E1) User's Manual	IM 04L51B01-18EN

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9.0 Appendix
9.1 Data Recording and Storage Flowchart

Measured data is recorded once to the internal memory and then saved to the external storage medium.

9.2 Internal Memory

Display data and event data are held in files in the internal memory. They are also saved files to an external storage medium.
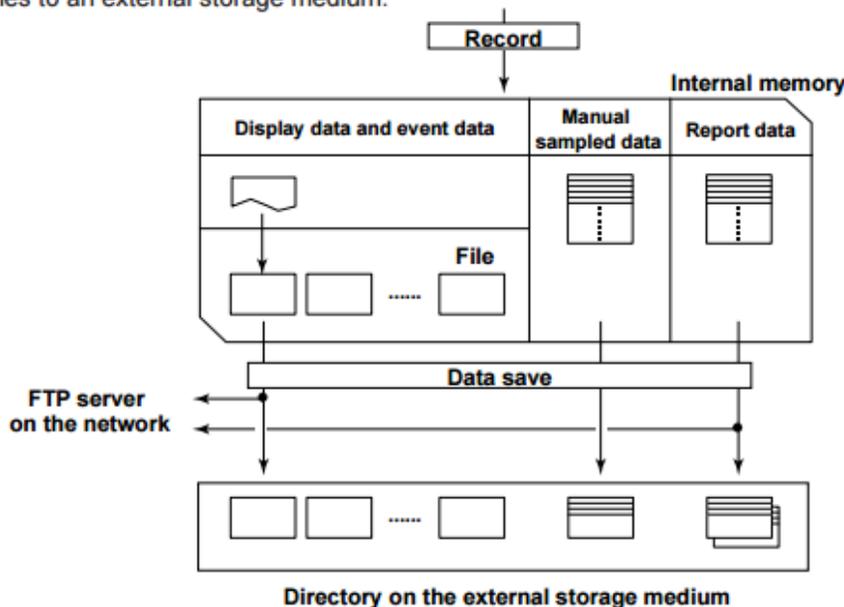
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The types of data that the GX/GP can store to files are listed below.
▶ For information about file name extensions, see page 1-14.

Data Type	Description
Display data	• Waveform data displayed on the trend display. The measured data is recorded at the specified trend interval. • The minimum and maximum values among the measured data within the trend interval are saved. • A header string (shared with other files) can be written in the file. • The file contains alarm and message information, an event log, login information, and setting parameters. • Data format: Binary (undisclosed) The data is encrypted.
Event data	• Measured data that is recorded at the specified recording interval. The only available recording mode is Free. You cannot start recording with triggers. • A header string (shared with other files) can be written in the file. • The file contains alarm and message information, an event log, login information, and setting parameters. • Data format: Binary (undisclosed) The data is encrypted.
Manual sampled data	• Instantaneous value of the measured data when a manual sample operation is executed. • A header string (shared with other files) can be written in the file. • Data format: Text
Report Data (/MT option)	• Hourly, daily, weekly, monthly, batch, daily custom report data. Report data is created at an interval that is determined by the report type (one hour for hourly reports, one day for daily reports, and so on). • A header string (shared with other files) can be written in the file. • Data format: Text • The data can be converted to Excel and PDF formats.
Snapshot data (screen image data)	• GX/GP screen image data. • Can be saved to an SD memory card or USB flash memory. • Data format: PNG
Setting parameters	• The setting parameters of the GX/GP. • Data format: Binary (undisclosed) The data is encrypted.
Alarm summary data	• The alarm summary information in the internal memory is saved to a text file. • Can be saved to a SD memory card and USB flash memory.