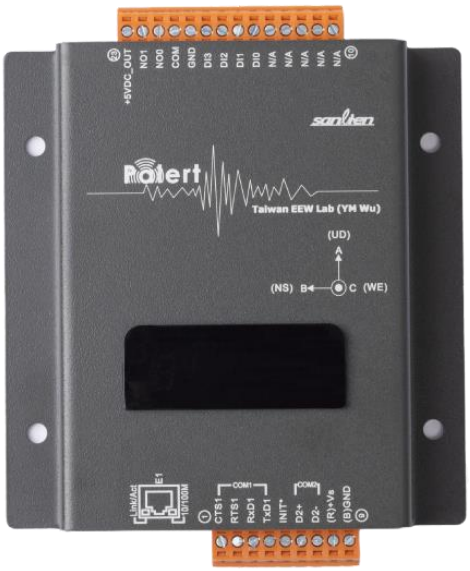
Sanlien Technology Corp.

# Palert

## Network Accelerometer




## User Manual

**V1.04**
2022/05

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# Menu

# Version Record

| Date | Description | Author |
|---|---|---|
| 20100415 | Initial version 0.01. | Ching |
| 20100418 | Finalized initial version 1.00 | Ching |
| 20100429 | Initialization time for deleting data and writing flags at address 113. | Ching |
| 20100507 | Added description for streaming packet Pd 300. | Ching |
| 20100603 | Increased the size of the streaming packet from 1100 bytes to 1200 bytes.<br>Added DI/O status and EEW register to the streaming packet | Ching |
| 20100612 | Revised the explanation for DO.<br>Added explanation for escape code at address 113 and FTP update code.<br>Added explanation for the packet sent when connecting to the server with a serial number. | Ching |
| 20100615 | Added Pa, Pv, and Pd to the streaming packet. | Ching |
| 20100616 | Added types 1191 and 1192 to the streaming packet. | Ching |
| 20100623 | Explanation of FTP server IP. | Ching |
| 20100913 | Added maximum acceleration values for each axis and synthesized vector in the streaming packet. | Ching |

| Date | Description | Author |
|---|---|---|
| 20100916 | Change in DHCP configuration method. | Ching |
| 20110323 | Correction of the description regarding the size of the streaming packet. | Ching |
| 20110419 | Change in Modbus RTU port configuration method (Version 2028). | Ching |
| 20110620 | Revised explanation for DO control. | Ching |
| 20120313 | 1. Added synchronization string to the streaming packet (Version 2056).<br>2. Modified trigger recommendations for PGA and Pd.<br>3. Supplemental explanation of the unit for tau-c.<br>4. Modified GB/T seismic intensity standards.<br>5. Modified units: Pa: count / sec^2, Pv: 0.01 cm/sec | Ching |
| 20120413 | Corrected the unit for PGV to 0.01 cm/sec. | Ching |
| 20120419 | Stream packet increased in length by word. | Ching |
| 20120903 | Added connection functionality with the Sanlien service host (Version 2068). | Ching |
| 20120906 | Added Modbus TCP Client functionality (Version 2069). | Ching |

| Date | Description | Author |
|---|---|---|
| 20121205 | Revised the explanation for real-time vectors.<br>Supplemental explanation for the actions of DOs.<br>Standardized the use of alert and warning terms. | Ching |
| 20130822 | Added EEWS DO0, 1 Intensity (V.2077) | Ching |
| 20140107 | Added connection to FTE-D04 EEWS alert device (Version 2080).<br>Added MMI seismic intensity standards and modified display method (Version 2081). | Ching |
| 20140324 | Revised the priority order of Palert NTP calibration to NTP server, TCP server 0, TCP server 1 (Version 2085). | Ching |
| 20171221 | Added KMA seismic intensity standards (Version 2102). | Ching |
| 20200428 | Added whitelist, installation angle, and CWB 2019 seismic intensity level. | Ching |
| 20220929 | Added functionality to adjust the school frequency to comply with HAZUS (Version 2117).<br>Added CRC check to the waveform packet (Version 2118).<br>Added the ability to disable Mode2 packet (Version 2118). | Ting |

# 1. Features

Palert is an advanced seismic P-wave alert system. In addition to the traditional function of electronic seismic switches, it embeds seismic detection and reporting technology developed by Professor Wu Yimin of National Taiwan University. This technology can detect seismic P-wave messages and determine within 3 seconds whether it is a catastrophic earthquake, providing users with on-site earthquake early warnings for disaster reduction.

Palert contains a three-axis Micro-Electro-Mechanical Systems (MEMS) accelerometer, two sets of solid-state relays for connecting and controlling external devices, 10/100MHz network and RS-232/RS-485 communication capabilities. It also has a built-in small LED display for information. Palert is designed as a compact, powerful All-in-One seismic instrument.

The main feature of this device is its earthquake discrimination technology, which provides four mechanisms for earthquake determination: Pd, PGA, displacement, and STA/LTA. The Pd earthquake determination mechanism is created by Professor Wu Yimin of National Taiwan University. Please refer to Appendix One of this manual for related information. PGA stands for Peak Ground Acceleration, and the device has two low-pass filters, 10Hz and 20Hz, to filter out non-earthquake high-frequency signals. Palert also performs real-time displacement processing for the vertical axis, allowing earthquake determination based on vertical displacement. The traditional earthquake determination logic of STA/LTA (STA short-period acceleration average / LTA long-period acceleration average) is also supported.

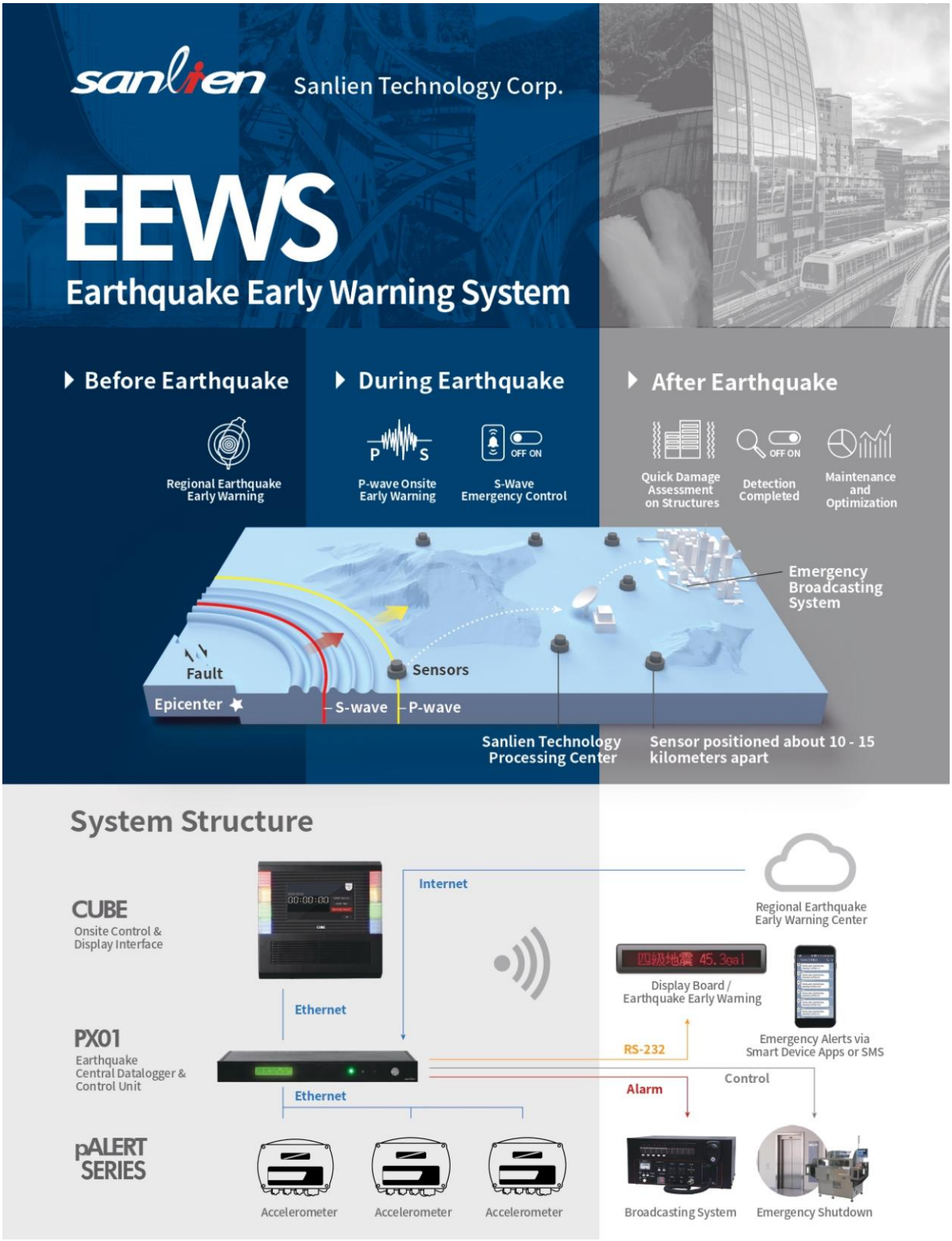
Palert has a built-in real-time clock (RTC) and provides NTP network time calibration function, displaying the current accurate time and recording the correct occurrence time, intensity, and maximum acceleration of the most recent earthquake event. It can display the seven-level seismic intensity issued by the Central Weather Bureau, or the seismic intensity of GB/T in mainland China, including maximum seismic intensity, three-axis composite vector acceleration, and instantaneous maximum acceleration.

Palert also supports the Modbus RTU and Modbus TCP industrial standard communication protocols, simultaneously supporting TCP/IP Client and TCP/IP Server functions. This allows direct connection to computers, PLCs, and human-machine interfaces. When using the Modbus TCP protocol, up to three computers or hosts can be connected simultaneously, allowing direct connection to broadcasting and disaster prevention systems for automatic monitoring of factory and building safety.

For users unfamiliar with control software, operation can be performed through the device's application software, Palert Early Warning System. In addition to general settings, it can record seismic waves for later analysis.

Our company also offers the i-touch touchscreen human-machine interface, which is ideal for on-site earthquake early warnings. For further information, please visit our company website at http://www.sanlien.com.

# 2. System Diagram



# 3. Hardware

## 3.1 Hardware Wiring Instructions

| Pin | Description |
|---|---|
| GND | Ground |
| Vs+ | Power Supply 10~30VDC 300mA |
| D2- | COM2 (RS-485 D-) |
| D2+ | COM2 (RS-485 D+) |
| INIT* | Reserved |
| TXD1 | COM TX |
| RXD1 | COM1 RX |
| RTS1 | COM1 RTS |
| CTS1 | COM1 CTS |
| E1 | Modbus TCP standard 10/100M Ethernet |
| DO PWR | 5V Output |
| DO0 | Alarm 0 Output A Point (Photo MOS Relay, Form A) Normal Open, 0.6A/60VDC |
| DO1 | Alarm 1 Output A Point (Photo MOS Relay, Form A) Normal Open, 0.6A/60VDC |
| DO COM | Alarm 0 and 1 Output Common Point |
| GND | 0 V |
| DI0 | Digital Input Point 0 (LED display will show IP when grounding) |
| DI1 | Digital Input Point 1 (LED display will show Last Event Information when grounding) |
| DI2 | Digital Input Point 2 (RTD Output Mode) |
| DI3 | Digital Input Point 3 (Reserved) |

## 3.2 LED Seven-Segment Display

The LED seven-segment display has different display formats in various states:

No Earthquake Event:

Displays year, month, day, day of the week, hour, minute, and second.

Display format: "YYYY.MM.DD WWW hh.mm.ss".

If NTP time synchronization is enabled but cannot sync with the NTP Server, the display will flash.

- Format Explanation:

YYYY: Year (AD)

MM: Month

DD: Day

WWW: Day of the week

hh: Hour

mm: Minute

ss: Second

During an Earthquake Event:

Displays the maximum intensity, maximum acceleration, and trigger mode.

If set to CWB old intensity levels and MMI mode, the display format is: "int.I aaaa.a P.d.A.t.".

If set to GB/T mode, the display format is: "II aa.aaa P.d.A.t.".

If set to CWB current intensity levels (new system) mode, there are four formats:

Intensity 0 to 4: "I aaaa.a P.d.A.t."

Intensity 5 weak and 6 weak: "I-Lo vvv.vv P.d.A.t."

Intensity 5 strong and 6 strong: "I-Hi vvv.vv P.d.A.t."

Intensity 7: "I vvv.vv P.d.A.t.“

- Format Explanation:

I: Maximum earthquake intensity

I-Lo: Weak earthquake

I-Hi: Strong earthquake

aaaa.a: Maximum composite acceleration, unit: gal

vvv.vv: Maximum composite velocity, unit: cm/sec^2

P: Pd trigger

d: Displacement trigger

A: PGA trigger

t: STA/LTA trigger

During an Earthquake Event:

Displays the maximum intensity, maximum acceleration, and trigger mode.

If set to CWB old intensity levels and MMI mode, the display format is: "int.I aaaa.a P.d.A.t.".

If set to GB/T mode, the display format is: "II aa.aaa P.d.A.t.".

If set to CWB current intensity levels (new system) mode, there are four formats:

Intensity 0 to 4: "I aaaa.a P.d.A.t."

Intensity 5 weak and 6 weak: "I-Lo vvv.vv P.d.A.t."

Intensity 5 strong and 6 strong: "I-Hi vvv.vv P.d.A.t."

Intensity 7: "I vvv.vv P.d.A.t.“

- Format Explanation:

I: Maximum earthquake intensity

I-Lo: Weak earthquake

I-Hi: Strong earthquake

aaaa.a: Maximum composite acceleration, unit: gal

vvv.vv: Maximum composite velocity, unit: cm/sec^2

P: Pd trigger

d: Displacement trigger

A: PGA trigger

t: STA/LTA trigger

When Receiving Earthquake Warning Messages from the Server:

Displaying Expected Earthquake Intensity and Estimated Arrival Time of Seismic Waves:

- Display format: "II.-99"

II: Expected seismic intensity.

-99: Seconds until the arrival of seismic waves.

For CWB New Intensity Grading Standard:

Display format varies based on intensity:

Intensity 1 to 4, and 7: "I.-99"

Intensity 5 weak and 6 weak: "I.¬¬¬¬┘ .-99"

Intensity 5 strong and 6 strong: "I.┐ .-99"

I: Expected seismic intensity (intensity).

-99: Seconds until the expected arrival of seismic waves.

- Note: This functionality is based on having a system set up to receive earthquake monitoring data from the server. Please be aware of the earthquake information laws and regulations in each country.

Since January 1, 2014, Sanlien Technology can provide earthquake warning information provided by the Central Weather Bureau in Taiwan. For related services, please contact Sanlien Technology's representatives for further information and support.

## 3.3. Input Terminal Functions

Restore to Factory Settings:

- When all four DI (Digital Input) terminals are grounded during power-up, Palert will reset all parameters to their factory default values.

Display IP Information:

- When DI0 is grounded, the seven-segment display will show the local IP information in the format of "XXX.XXX.XXX.XXX.“
- Avoid subjecting Palert to any vibrations; otherwise, it will switch to displaying earthquake information.

Display Last Earthquake Information:

- When DI1 is grounded, the seven-segment display will show the latest earthquake information in the following formats based on the operational mode:
- For CWB Old System and MMI Mode:
    - YYYY: Year of the earthquake occurrence in the Gregorian calendar.
    - MM: Month.
    - DD: Day.
    - hh: Hour.
    - mm: Minute.
    - ss: Second.
    - int.I: Maximum seismic intensity.
    - aaaa.a: Maximum acceleration (gal).

For CWB New System Mode:

- Depending on the seismic intensity, there are four display formats:
  - Intensity 0-4: "YYYY.MM.DD hh.mm.ss -I- aaaa.a“
  - Intensity 5 (Weak) and 6 (Weak): "YYYY.MM.DD hh.mm.ss -I-Lo vvv.vv“
  - Intensity 5 (Strong) and 6 (Strong): "YYYY.MM.DD hh.mm.ss -I-Hi vvv.vv“
  - Intensity 7: "YYYY.MM.DD hh.mm.ss -I- vvv.vv“
  - YYYY: Year of the earthquake occurrence in the Gregorian calendar.
  - MM: Month.
  - DD: Day.
  - hh: Hour.
  - mm: Minute.
  - ss: Second.
  - -I-: Maximum seismic intensity.
  - Lo: Represents weak earthquakes.
  - Hi: Represents strong earthquakes.
  - aaaa.a: Maximum combined acceleration (gal).
  - vvv.vv: Maximum combined speed (cm/sec).

For GB/T Mode:

- Format: "YYYY.MM.DD hh.mm.ss II aa.aaa"
  - YYYY: Year of the earthquake occurrence in the Gregorian calendar.
  - MM: Month.
  - DD: Day.
  - hh: Hour.
  - mm: Minute.
  - ss: Second.
  - II: Maximum seismic intensity.
  - aa.aaa: Maximum horizontal combined acceleration (m / sec^2).

Temporary Suspension of Whitelist Function:

- When DI1 is grounded, it allows for the temporary suspension of the whitelist function. This feature does not impact the original settings; it only temporarily disables the whitelist function.

## 3.4. Modbus RTU Port:

Palert's Modbus RTU port is initially set to COM2. Users have the flexibility to change it to COM1 based on their specific requirements. The hardware communication protocol for this port is 19200, N, 8, 1. For details on configuring this port, refer to the explanation provided in Address 201.

Additionally, the device can output real-time vibration data in RTD format through the serial communication port. The RTD port is automatically selected based on the Modbus RTU port configuration. If Modbus RTU port is set to COM1, then the RTD port is set to COM2, and vice versa. Please refer to Section 3.5 for more details.

## 3.5. RTD (Real Time Data Stream) Output Control Function:

When DI2 is grounded, Palert activates the RTD output function with the following output format:

| Byte 1 | Byte 2 | Byte 3 | Byte 4 | Byte 5 | Byte 6 | Byte 7 | Byte 8 |
|---|---|---|---|---|---|---|---|
| 0x0d | a High | a Low | b High | b Low | c High | c Low | 0x0a |

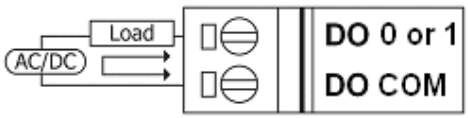
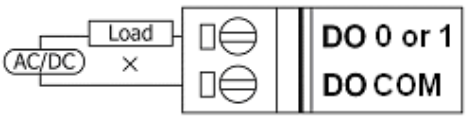
The communication port for this RTD output is determined by the Modbus RTU port, as explained in section 3.4. The hardware communication protocol is fixed at 9600, n, 8, 1. Additionally, users should note that in this mode, two sets of DO are controlled by the RTD port, and the vibration data from RTD is unfiltered and without zero-point correction. DO control protocol:

| | ON | OFF |
|---|---|---|
| DO0 | #ON0#\r | #OFF0#\r |
| DO1 | #ON1#\r | #OFF1#\r |

- \r represents 0x0d

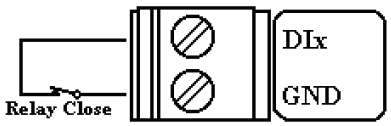
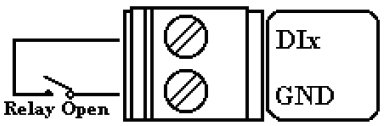
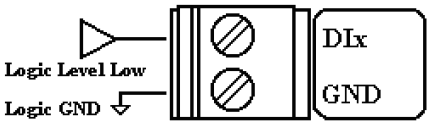
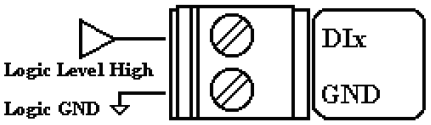
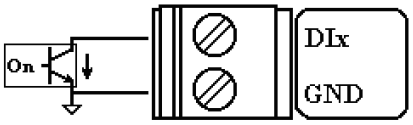
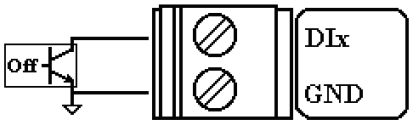
## 3.6. DO Wiring and Operation

You can consider DO (Digital Output) as a switch. In the diagram below, AC/DC represents the power supply required for the load, and the load is denoted as "Load." When the DO output is set to 1, as shown on the left side of the diagram, current can flow through the load. If DO is set to 0, as shown on the right side of the diagram, no current will flow through the load. It's important to note that the capacity of DO is 60V at 0.6A.

| Output Type | Readback as 1 | Readback as 0 |
|---|---|---|
| | Relay On | Relay Off |
| From A Relay Contact |   |   |

## 3.7. DI Wiring

The simplest way to use DI (Digital Input) is by using a switch to control its state. Not connected to ground (short circuit between Dix and GND) is one state, and connected to ground is another state. Please refer to the diagram below in the first column, which illustrates the Relay Contact's graphical explanation (a regular switch can replace the relay). Other wiring methods are shown in the next two columns. Since DI does not have isolation processing, it is recommended to use the first method.

| Input Type | ON State DI value as 1 | OFF State DI value as 0 |
|---|---|---|
| Relay Contact |   |   |
| TTL/CMOS Logic |   |   |
| Open Collector |   |   |

### 3.8. Mounting and Installation

Palert should be fixed with the a-axis as the vertical direction. Additionally, to avoid human impact, it is recommended to install a transparent box around Palert. In order to ensure continuous monitoring even when the power is lost, you can connect a battery in parallel for power supply.

# 4. Installation and Configuration Instructions

When Palert is shipped, the seismic mode detection parameters are preset to optimize performance. However, adjustments may be necessary at times due to factors such as excessive background vibration noise at the installation site. Therefore, the following provides an explanation of all parameters for Palert.

Note: In the context below, 40XXX or XXX represents the Modbus register address used by the PLC, with only 40100 to 40205 currently defined. Register Offset refers to the register address used in Modbus commands. R/W indicates the read/write status, where R stands for Read Only, W stands for Write Only, and RW means it is both readable and writable. Label represents the variable name, and Description provides a brief functional description. For more detailed descriptions, refer to the next section.

## 4.1. Parameter Overview Table:

| Palert Modbus Point Table (40XXX) | | | | |
|---|---|---|---|---|
| **XXX** | **Register Offset** | **R/W** | **Label** | **Description** |
| 100 | 0x0063 | R | connection_flag | NTP Server synchronization flag and server connection flag |
| 101 | 0x0064 | R | a_axis | Real-time acceleration on axis A |
| 102 | 0x0065 | R | b_axis | Real-time acceleration on axis B |
| 103 | 0x0066 | R | c_axis | Real-time acceleration on axis C |
| 104 | 0x0067 | R | vector | Real-time acceleration vector sum on three axes |
| 105 | 0x0068 | R | a_offset | Zero-point compensation on axis A |
| 106 | 0x0069 | R | b_offset | Zero-point compensation on axis B |
| 107 | 0x006A | R | c_offset | Zero-point compensation on axis C |
| 108 | 0x006B | R | vector_gal_max | Maximum value of the synthesized vector on three axes |
| 109 | 0x006C | R | intensity_now | Current seismic intensity |
| 110 | 0x006D | R | intensity_max | Maximum seismic intensity |
| 111 | 0x006E | R | event | Earthquake flag |

| Palert Modbus Point Table (40XXX) | | | | |
|---|---|---|---|---|
| **XXX** | **Register Offset** | **R/W** | **Label** | **Description** |
| 112 | 0x006F | R | lta_flag | LTA flag |
| 113 | 0x0070 | W | data_changed | Data write flag (1 indicates modification, 2 indicates writing to EEPROM, 4 indicates writing IP address to EEPROM, 8 indicates changing system time, 16 indicates changing Server IP address) |
| 114 | 0x0071 | RW | time_diff | Time zone (Taipei is 8) |
| 115 | 0x0072 | RW | sta_time | STA length, in units of 0.1 seconds |
| 116 | 0x0073 | RW | lta_time | LTA length, in units of 0.1 seconds |
| 117 | 0x0074 | RW | sta_lta_th | Seismic detection STA/LTA threshold |
| 118 | 0x0075 | RW | op_mode | GB/T mode, DO control mode, composite vector intensity calculation, active connection to Server, NTP synchronization, DHCP, Modbus TCP Client |
| 119 | 0x0076 | R | DIO_status | Status of DI and DO |
| 120 | 0x0077 | RW | event_time | Earthquake alarm occurrence time, in seconds |
| 121 | 0x0078 | RW | pga_watch_threshold | PGA alert value, in count |
| 122 | 0x0079 | RW | offset_records | Number of samples required for zero-point calibration |
| 123 | 0x007A | RW | DO0_gal | DO0 activation value, in units of gal |

| Palert Modbus Point Table (40XXX) | | | | |
|---|---|---|---|---|
| **XXX** | **Register Offset** | **R/W** | **Label** | **Description** |
| 124 | 0x007B | RW | DO1_gal | DO1 activation value, in units of gal |
| 125 | 0x007C | R | PGV_1S | Maximum velocity value in any of the three axes within one second, in units of 0.01 cm/s |
| 126 | 0x007D | R | PGD_1S | Maximum displacement value in any of the three axes within one second, in units of 0.001 cm |
| 127 | 0x007E | R | Last_event | Last earthquake trigger message |
| 128 | 0x007F | R | sta_lta | Current value of STA/LTA |
| 129 | 0x0080 | R | a_maximum | Maximum acceleration in the a-axis during the earthquake event |
| 130 | 0x0081 | R | b_maximum | Maximum acceleration in the b-axis during the earthquake event |
| 131 | 0x0082 | R | c_maximum | Maximum acceleration in the c-axis during the earthquake event |
| 132 | 0x0083 | R | vector_max_a | Maximum composite vector acceleration in the a-axis during the earthquake event |
| 133 | 0x0084 | R | vector_max_b | Maximum composite vector acceleration in the b-axis during the earthquake event |
| 134 | 0x0085 | R | vector_max_c | Maximum composite vector acceleration in the c-axis during the earthquake event |
| 135 | 0x0086 | R | pga_trig_axis | Axis triggered by PGA |

| Palert Modbus Point Table (40XXX) | | | | |
|---|---|---|---|---|
| **XXX** | **Register Offset** | **R/W** | **Label** | **Description** |
| 136 | 0x0087 | R | pv_int | a-axis instantaneous velocity, unit 0.01 cm/second |
| 137 | 0x0088 | R | pd_int | a-axis instantaneous Pd value, unit 0.001 cm |
| 138 | 0x0089 | R | tc_int | a-axis instantaneous τc value |
| 139 | 0x008A | R | pd_flag | Pd trigger status |
| 140 | 0x008B | R | pga_10s | Maximum PGA value within 10 seconds, unit count |
| 141 | 0x008C | R | e_year | Earthquake event time record - year |
| 142 | 0x008D | R | e_month | Earthquake event time record - month |
| 143 | 0x008E | R | e_day | Earthquake event time record - day |
| 144 | 0x008F | R | e_hour | Earthquake event time record - hour |
| 145 | 0x0090 | R | e_minute | Earthquake event time record - minute |
| 146 | 0x0091 | R | e_second | Recorded time of the earthquake event in seconds |
| 147 | 0x0092 | R | sys_year | System time - year |

| Palert Modbus Point Table (40XXX) | | | | |
|---|---|---|---|---|
| **XXX** | **Register Offset** | **R/W** | **Label** | **Description** |
| 148 | 0x0093 | R | sys_month | System time - month |
| 149 | 0x0094 | R | sys_day | System time - day |
| 150 | 0x0095 | R | sys_hour | System time - hour |
| 151 | 0x0096 | R | sys_minute | System time - minute |
| 152 | 0x0097 | R | sys_second | System time - second |
| 153 | 0x0098 | RW | set_year | Set system time - year |
| 154 | 0x0099 | RW | set_month | Set system time - month |
| 155 | 0x009A | RW | set_day | Set system time - day |
| 156 | 0x009B | RW | set_hour | Set system time - hour |
| 157 | 0x009C | RW | set_minute | Set system time - minute |
| 158 | 0x009D | RW | set_second | Set system time - second |
| 159 | 0x009E | R | displacement | a-axis instantaneous displacement, unit 0.001 cm |

| Palert Modbus Point Table (40XXX) | | | | |
|---|---|---|---|---|
| **XXX** | **Register Offset** | **R/W** | **Label** | **Description** |
| 160 | 0x009F | RW | disp_warning_threshold | a-axis displacement warning level, unit 0.001 cm |
| 161 | 0x00A0 | RW | pga_warning_threshold | PGA warning level, unit count |
| 162 | 0x00A1 | RW | pd_warning_threshold | Pd warning level, unit 0.001 cm |
| 163 | 0x00A2 | RW | trig_mode | Low-pass filtering mode, trigger mode selection |
| 164 | 0x00A3 | RW | pd_watch_threshold | Pd alert value, unit 0.001 cm |
| 165 | 0x00A4 | RW | x_0g | 0g a-axis correction factor (unit: 0.1 mg) at 0g |
| 166 | 0x00A5 | RW | y_0g | 0g b-axis correction factor (unit: 0.1 mg) at 0g |
| 167 | 0x00A6 | RW | z_0g | 0g c-axis correction factor (unit: 0.1 mg) at 0g |
| 168 | 0x00A7 | RW | x_1g | 1g a-axis correction factor (unit: 0.1 mg) at 1g |
| 169 | 0x00A8 | RW | y_1g | 1g b-axis correction factor (unit: 0.1 mg) at 1g |
| 170 | 0x00A9 | RW | z_1g | 1g c-axis correction factor (unit: 0.1 mg) at 1g |
| 171 | 0x00AA | RW | ntp_svr_ip1 | Network time server IP Address 1 |

| Palert Modbus Point Table (40XXX) | | | | |
|---|---|---|---|---|
| **XXX** | **Register Offset** | **R/W** | **Label** | **Description** |
| 172 | 0x00AB | RW | ntp_svr_ip2 | Network time server IP Address 2 |
| 173 | 0x00AC | RW | ntp_svr_ip3 | Network time server IP Address 3 |
| 174 | 0x00AD | RW | ntp_svr_ip4 | Network time server IP Address 4 |
| 175 | 0x00AE | R | week_day | System day of the week |
| 176 | 0x00AF | RW | Server0_ip12 | TCP Server 0 IP Address 1, 2 |
| 177 | 0x00B0 | RW | Server0_ip34 | TCP Server 0 IP Address 3, 4 |
| 178 | 0x00B1 | RW | Server1_ip12 | TCP Server 1 IP Address 1, 2 |
| 179 | 0x00B2 | RW | Server1_ip34 | TCP Server 1 IP Address 3, 4 |
| 180 | 0x00B3 | RW | IP1 | Palert IP address 1/4 |
| 181 | 0x00B4 | RW | IP2 | Palert IP address 2/4 |
| 182 | 0x00B5 | RW | IP3 | Palert IP address 3/4 |
| 183 | 0x00B6 | RW | IP4 | Palert IP address 4/4 |

| Palert Modbus Point Table (40XXX) | | | | |
|---|---|---|---|---|
| **XXX** | **Register Offset** | **R/W** | **Label** | **Description** |
| 184 | 0x00B7 | RW | subnet_mask1 | Palert IP subnet mask 1/ 4 |
| 185 | 0x00B8 | RW | subnet_mask2 | Palert IP subnet mask 2/ 4 |
| 186 | 0x00B9 | RW | subnet_mask3 | Palert IP subnet mask 3/ 4 |
| 187 | 0x00BA | RW | subnet_mask4 | Palert IP subnet mask 4/ 4 |
| 188 | 0x00BB | RW | gateway1 | Palert IP gateway 1 / 4 |
| 189 | 0x00BC | RW | gateway2 | Palert IP gateway 2 / 4 |
| 190 | 0x00BD | RW | gateway3 | Palert IP gateway 3 / 4 |
| 191 | 0x00BE | RW | gateway4 | Palert IP gateway 4 / 4 |
| 192 | 0x00BF | R | sck_remain | Remaining connectable hosts (TCP/IP) |
| 193 | 0x00C0 | W | stream_output | Streaming data output control |
| 194 | 0x00C1 | RW | rtu_address | Palert Modbus RTU address |
| 195 | 0x00C2 | RW | light_sound_duration | Alert and warning time |

| Palert Modbus Point Table (40XXX) | | | | |
|---|---|---|---|---|
| **XXX** | **Register Offset** | **R/W** | **Label** | **Description** |
| 197 | 0x00C4 | RW | disp_watch_threshold | a-axis displacement warning level, unit 0.001 cm |
| 198 | 0x00C5 | RW | pre-alarm | Earthquake warning (used by the earthquake server) |
| 199 | 0x00C6 | R | version | Firmware version |
| 200 | 0x00C7 | RW | serial_no | Palert machine serial number |
| 201 | 0x00C8 | RW | mbus_port | Modbus RTU port settings |
| 202 | 0x00C9 | RW | eewsDO0 | Regional earthquake warning DO0 action intensity |
| 203 | 0x00CA | RW | eewsDO1 | Regional earthquake warning DO1 action intensity |
| 204 | 0x00CB | RW | Fted04IP12 | Earthquake warning alarm FTE-D04 IP1, 2 |
| 205 | 0x00CC | RW | Fted04IP34 | Earthquake warning alarm FTE-D04 IP3, 4 |
| 206 | 0x00CD | RW | installAngle | Installation angle |
| 207 | 0x00CE | RW | dynamicOffset | Dynamic zero setting |
| 208 | 0x00CF | RW | opModeX | Extended operation mode setting |

| Palert Modbus Point Table (40XXX) | | | | |
|---|---|---|---|---|
| **XXX** | **Register Offset** | **R/W** | **Label** | **Description** |
| 209 | 0x00D0 | RW | whiteIp0 | Whitelist 1 IP1, 2 |
| 210 | 0x00D1 | RW | whiteIp0 | Whitelist 1 IP3, 4 |
| 211 | 0x00D2 | RW | whiteIp2 | Whitelist 2 IP1, 2 |
| 212 | 0x00D3 | RW | whiteIp2 | Whitelist 2 IP3, 4 |
| 213 | 0x00D4 | RW | whiteIp3 | Whitelist 3 IP1, 2 |
| 214 | 0x00D5 | RW | whiteIp3 | Whitelist 3 IP3, 4 |
| 273 | 0x0110 | RW | vectorVelocityMax | Maximum synthetic speed |
| 274 | 0x0111 | RW | pgvWatchThreshold | Speed trigger caution value |
| 275 | 0x0112 | RW | pgvWarningThreshold | Speed trigger warning value |
| 300 | 0x012B | RW | selfTest | Self-test |

## 4.2. Parameter Explanation

Address 100, NTP Server synchronization flag and Server connection flag

**bit 0**

When synchronized with the network time server, the value is 1; if it is 0, it means not synchronized with the network time server.

Palert initiates network time synchronization every 10 minutes. If it fails to synchronize with the NTP server, it retries every 10 seconds. If synchronization is not achieved within 700 seconds, Palert closes the NTP socket and opens a new one. For the IP address settings of this NTP server, please refer to addresses 171-174.

**bit 1**

Indicates Palert's active connection to TCP Server0. A value of 1 signifies a successful connection, while 0 indicates no connection. For the IP address settings of this TCP Server, please refer to addresses 176-177.

**bit 2**

Indicates Palert's active connection to TCP Server1. A value of 1 signifies a successful connection, while 0 indicates no connection. For the IP address settings of this TCP Server, please refer to addresses 178-179.

**bit 3**

Indicates Palert's active connection to the Three-Links Technology service server.

**bit 4**

Indicates the connection status between Palert and the earthquake early warning alarm FTE-D04.

For the above functions, NTP and Server Connection must be set to Enable. Please refer to address 118 for op_mode settings.

Address 101, a-axis real-time acceleration

Real-time output of a-axis acceleration, in units of counts. 1 gal is equivalent to 16.718 counts. When connected to a host in an Ethernet environment, the output rate is approximately 100 samples per second.

Address 102, b-axis real-time acceleration

Real-time output of b-axis acceleration, in units of counts. 1 gal is equivalent to 16.718 counts. When connected to a host in an Ethernet environment, the output rate is approximately 100 samples per second.

Address 103, c-axis real-time acceleration

Real-time output of c-axis acceleration, in units of counts. 1 gal is equivalent to 16.718 counts. When connected to a host in an Ethernet environment, the output rate is approximately 100 samples per second.

Address 104, real-time acceleration synthesis vector

If the CWB intensity calculation standard is selected, this address stores the real-time output of the acceleration synthesis vector for three axes, in units of counts. 1 gal is equivalent to 16.718 counts. The calculation formula is as follows:

$$Vector = \sqrt{a^2 + b^2 + c^2}$$

Note that here, the b and c axes refer to the two horizontal axes of installation. Palert will automatically determine these two horizontal axes based on gravity during initialization.

Address 105: a-axis zero offset compensation

Accelerometers may experience zero drift due to factors such as the horizontal orientation of the installation location or the environment. Palert has an automatic zeroing function, and this value represents the zero offset compensation for the a-axis, in units of counts. One gal is equivalent to approximately 16.718 counts. It's important to note that due to the influence of gravity on the a-axis, there will be an offset drift of nearly -980 gal, which is normal.

Address 106: b-axis zero offset compensation

Accelerometers may experience zero drift due to factors such as the horizontal orientation of the installation location or the environment. Palert has an automatic zeroing function, and this value represents the zero offset compensation for the b-axis, in units of counts. One gal is equivalent to approximately 16.718 counts.

Address 107: c-axis zero offset compensation

Accelerometers may experience zero drift due to factors such as the horizontal orientation of the installation location or the environment. Palert has an automatic zeroing function, and this value represents the zero offset compensation for the c-axis, in units of counts. One gal is equivalent to approximately 16.718 counts.

Address 108: Maximum composite vector

When an earthquake occurs, this address will store the maximum acceleration value of the composite vector for the current seismic event, with a unit of 0.1 gal. This value will remain unchanged until the next earthquake occurs.

The content of this address will be determined based on the settings of address 118 (op_mode) and address 208, indicating whether it is the GB/T horizontal vector, the composite vector, or the maximum value of the three axes.

Address 109: Current intensity

When an earthquake occurs, this address will store the real-time seismic intensity for the current seismic event. The intensity level is determined based on the seismic intensity standard set by the user, whether it's the CWB old intensity classification standard (please refer to Table 1), the intensity classification standard officially implemented by CWB on January 1, 109 (please refer to Table 2), or the GB/T seismic intensity table. Refer to the settings of address 118 and address 208.

CWB Old Standard:

Palert calculates the intensity based on the real-time synthesized acceleration values in all three axes or can use the maximum values in each axis as the basis for calculating the intensity level. CWB defines intensity levels from 1 to 7.

CWB New Standard:

Palert calculates the intensity based on both the real-time synthesized acceleration and velocity values in all three axes. For detailed calculation methods, please refer to Table 3. CWB defines intensity levels from 1 to 7. If the CWB new intensity classification standard is adopted, the values at this address correspond to the intensity as shown in the following table:

| Intensity | 1 | 2 | 3 | 4 | 5 weak | 5 strong | 6 weak | 6 strong | 7 |
|---|---|---|---|---|---|---|---|---|---|
| Value | 10 | 20 | 30 | 40 | 51 | 59 | 61 | 69 | 70 |

MMI:

Palert calculates the intensity based on the real-time synthesized acceleration values in all three axes or can use the maximum values in each axis as the basis for calculating the intensity level. MMI defines intensity levels from 0 to 10.

GB/T:

Palert determines seismic intensity based on the horizontal synthesized vector. The device will automatically determine which two-axis components are the horizontal components based on the installation orientation. However, during installation, it is advisable to keep the device either vertical or horizontal to achieve the best measurement accuracy. The seismic intensity standards are as follows:

- Level 1: <= 1.59 cm/sec^2
- Level 2: 1.60 ~ 3.27 cm/sec^2
- Level 3: 3.28 ~ 6.73 cm/sec^2
- Level 4: 6.74 ~ 13.86 cm/sec^2
- Level 5: 13.87 ~ 28.54 cm/sec^2
- Level 6: 28.55 ~ 58.76 cm/sec^2
- Level 7: 58.77 ~ 121 cm/sec^2
- Level 8: 122 ~ 249 cm/sec^2
- Level 9: 250 ~ 513 cm/sec^2
- Level 10: 514 ~ 1056 cm/sec^2
- Level 11: >= 1057 cm/sec^2

Address 110, Maximum Seismic Intensity

When an earthquake occurs, this address stores the maximum seismic intensity of the seismic event. The intensity is determined based on the user's settings for the CWB intensity classification standard (please refer to Appendix I and II) or MMI or the GB/T seismic intensity table. Please refer to the settings at addresses 118 and 208. If the new CWB intensity classification standard is adopted, the values at this address correspond to the intensity as follows:

| Intensity | 1 | 2 | 3 | 4 | 5 weak | 5 strong | 6 weak | 6 strong | 7 |
|---|---|---|---|---|---|---|---|---|---|
| Value | 10 | 20 | 30 | 40 | 51 | 59 | 61 | 69 | 70 |

Address 111 - Seismic Flags

During normal, non-seismic periods, the value is 0. When an earthquake occurs, the relevant bit positions in this address will be set to 1. After the time defined in Address 120, they will automatically be cleared to 0.

- Bit 0: Triggered by a-axis displacement.
- Bit 1: Triggered by Pd.
- Bit 2: Triggered by PGA.
- Bit 3: Triggered by STA/LTA.

Address 112 - LTA Flag

LTA stands for Long Time Average, which is the long-term average of acceleration. Another factor is STA, Short Time Average, which is the short-term average of acceleration. When the ratio of STA to LTA is greater than or equal to the set value (defaulted to 3 when the system is shipped) and the STA/LTA seismic detection logic is activated (bit 3 of Address 163 set to 1), it is considered an earthquake. Therefore, when Palert begins initialization, there must be sufficient time for Palert to accumulate and calculate the value of LTA. When this flag is set to 1, it indicates that Palert has accumulated enough data and has calculated the value of LTA. In other words, this flag must be 1 for the STA/LTA seismic detection mode to be active.

Address 113 - Data Write Flag

When making modifications to the settings of Palert, you must write the corresponding values to this address to officially complete the modification.

- Writing 2 indicates that the settings will be written to EEPROM and will force Palert to perform initialization.
- Writing 4 indicates that the IP, Mask, and Gateway addresses of Palert itself will be set and written to EEPROM, forcing Palert to perform initialization.
- Writing 8 indicates setting the system time. Palert will write the time information (year, month, day, hour, minute, second) from addresses 153 to 158 to the real-time clock (RTC).
- Writing 128 (0x80) forces Palert to exit the program and enter the operating system. Note that this command will stop Palert's operation, and it is used for firmware updates.
- Writing 384 (0x180) forces Palert to update the latest firmware from the FTP server specified by TCP Server 1.

During Palert initialization, it will recalculate the zero compensation values for three-axis acceleration and recalculate the values of LTA and STA.

Address 114 - Time Zone

When Palert connects to the NTP Server, it adds the content of this address to the UTC time to determine the local time. For example, the time zone for Taiwan is 8.

Address 115 – STA Duration

STA stands for Short Time Average, representing the short-term average acceleration, and LTA is Long Time Average, representing the long-term average acceleration. When the ratio of STA to LTA is greater than or equal to the set value (default is 3), and the STA/LTA seismic detection logic is activated (bit 3 of address 163 is set to 1), it is considered an earthquake occurrence. This address stores the duration for calculating STA, in tenths of a second, with a default value of 20, equivalent to 2 seconds. The larger the value, the more it can suppress spikes. The maximum value for this field is half of LTA. When modifying this address, you must write 2 to address 113 to apply this setting.

Address 116 – LTA Duration

LTA stands for Long Time Average, representing the long-term average acceleration, and STA is Short Time Average, representing the short-term average acceleration. When the ratio of STA to LTA is greater than or equal to the set value (default is 3), and the STA/LTA seismic detection logic is activated (bit 3 of address 163 is set to 1), it is considered an earthquake occurrence. This address stores the duration for calculating LTA, in tenths of a second, with a default value of 800, equivalent to 80 seconds. The maximum value is 2000, or 200 seconds. When modifying this address, you must write 2 to address 113 to apply this setting.

Address 117 – Earthquake Judgment STA/LTA Level

For the STA/LTA seismic detection logic, when bit 3 of address 163 is set to 1, and the ratio of STA to LTA (address 128) is greater than or equal to the set value at this address (default is 3), and the STA/LTA seismic detection logic is activated (bit 3 of address 163 is set to 1), it is considered an earthquake occurrence. After an event is triggered, refer to the table below for the DO actions (values with underlines indicate addresses). Simultaneously, bit 3 of address 111, the earthquake flag, will be set to 1.

| | DO0 | | DO1 | |
|---|---|---|---|---|
| **DO Status/Trigger Modes** | ON | OFF | ON | OFF |
| **Displacement Trigger 163 bit 0** | 159 > 197 | Timer >= 195 High byte | 159 > 160 | Timer >= 195 Low byte |
| **Pd Trigger 163 bit 1** | 137 > 164 | Timer >= 195 High byte | 137 > 162 | Timer >= 195 Low byte |
| **PGA Trigger 163 bit 2** | 104> 121 | Timer >= 195 High byte | 104 >161 | Timer >= 195 Low byte |
| **STA/LTA Trigger 163 bit 3** | 112 = 1 AND 128 >= 117 AND 108 > 123 | Timer >= 120 | 112 = 1 AND 128 >= 117 AND 108 > 124 | Timer >= 120 |

Address 118 – Operating Mode Configuration

**Bit 0** (Earthquake Intensity Discrimination Standard):

0: CWB (Taiwan) Standard

1: GB/T Standard

**Bit 1** (GAS_mode):

0: Standard DO Control Mode (ON time determined by earthquake trigger type)

1: Short DO Pulse Mode (2 seconds ON), suitable for controlling gas solenoid valves

**Bit 2** (Seismic Intensity Calculation Mode) - Only effective when adopting CWB and MM modes:

0: Calculation based on the maximum value of each component

1: Calculation based on the three-axis composite vector

**Bit** 3 (Active Connection to TCP Server 0):

0: Inactive (Function turned off)

1: Active (Function turned on)

**Bit 4** (NTP Network Time Synchronization):

0: Disable NTP network time synchronization

1: Enable NTP network time synchronization

**Bit 5** (DHCP Dynamic IP Acquisition):

0: Disable DHCP dynamic IP acquisition

1: Enable DHCP dynamic IP acquisition

**Bit 6** (Active Connection to TCP Server 1):

0: Inactive (Function turned off)

1: Active (Function turned on)

Note: When modifying the content of this bit, you must write 2 to Address 113 to force Palert to perform initialization to apply the new settings.

**Bit 7** (Disable Connection to Three-Links Technology Service Server):

0: Allow active connection to the Three-Links Technology service server (for firmware upgrade)

1: Disable active connection to the Three-Links Technology service server

**Bit 8** (Enable Connection to Earthquake Warning Alarm FTE-D04):

0: Disable connection to FTE-D04

1: Enable connection to FTE-D04

Note: For FTE-D04 IP settings, refer to Addresses 204-205.

Bit 9 (Enable MMI Intensity Standard):

0: Disable MMI intensity standard

1: Enable MMI intensity standard

**Bit 10** (Enable KMA Intensity Standard):

0: Disable KMA intensity standard

1: Enable KMA intensity standard

**Bit 15** (Modbus TCP Client Function):

0: Disable this function

1: Enable this function

Note: When this function is activated, Palert will actively write its 102 parameters to all connected servers using Modbus commands at a rate of one record per second. The written address on the server is determined by taking the remainder of the Palert's Modbus RTU address divided by 100 and multiplying it by 200.

Example: If the Palert's Modbus RTU address is 101, the written address on the server will be 200. If the Palert's Modbus RTU address is 104, the written address on the server will be 800.

Note: This function is suitable for connecting multiple Palerts to a control host to achieve a control mode similar to three out of two. This helps ensure that the system is not triggered by individual touches on each Palert, providing a more stable control mechanism.

Address 119 – Digital Input/Output Status

This address is updated every second to display the status of Digital Inputs (DI) and Digital Outputs (DO). The High Byte represents DI, and the Low Byte represents DO. Currently, there are 4 DI (bit 8 to bit 11) and 2 DO (bit 0 to bit 1). Additionally, users can use Modbus read DI instructions (FC = 0x02, PLC address = 100, 101, 102, 103 mapping to DI0, DI1, DI2, and DI3) and read DO instructions (FC = 0x01, PLC address = 100, 101 mapping to DO0 and DO1) to inquire about their status.

Address 120 – Earthquake Alert Time

When an earthquake event is triggered, Palert enters earthquake mode. In this mode, besides setting the earthquake flag (Address 111), it immediately updates the maximum intensity, real-time values of each axis's acceleration, and determines whether to activate the built-in relay. The duration of this earthquake event depends on the time set in this address, with the unit being seconds. The default value is 30 seconds.

During an earthquake, Palert starts counting time, and when the time exceeds the value in Address 120, it exits the earthquake mode. If there is a continuous strong vibration during the earthquake, Palert will restart the timer. Please refer to section 4.4.4 Earthquake Event Timing Diagram. (Values underlined in the table indicate the corresponding addresses.)

| | DO0 | | DO1 | |
|---|---|---|---|---|
| **DO Status/Trigger Modes** | ON | OFF | ON | OFF |
| **Displacement Trigger 163 bit 0** | 159 > 197 | Timer >= 195 High byte | 159 > 160 | Timer >= 195 Low byte |
| **Pd Trigger 163 bit 1** | 137 > 164 | Timer >= 195 High byte | 137 > 162 | Timer >= 195 Low byte |
| **PGA Trigger 163 bit 2** | 104> 121 | Timer >= 195 High byte | 104 >161 | Timer >= 195 Low byte |
| **STA/LTA Trigger 163 bit 3** | 112 = 1 AND 128 >= 117 AND 108 > 123 | Timer >= 120 | 112 = 1 AND 128 >= 117 AND 108 > 124 | Timer >= 120 |

Address 121 – PGA Alert Level Setting

This address stores the Peak Ground Acceleration (PGA) alert level, measured in counts. The recommended setting is 134 counts (8 gals). When bit 2 of Address 163 is set to 1, and the PGA value is greater than or equal to the set value, it indicates the triggering of an earthquake alert event. At the same time, bit 2 of the earthquake flag at Address 111 is set to 1. After the alert event is triggered, refer to the table below for the actions of the Digital Outputs (DO). (Values underlined in the table indicate the corresponding addresses.)

| | DO0 | | DO1 | |
|---|---|---|---|---|
| **DO Status/Trigger Modes** | ON | OFF | ON | OFF |
| **Displacement Trigger 163 bit 0** | 159 > 197 | Timer >= 195 High byte | 159 > 160 | Timer >= 195 Low byte |
| **Pd Trigger 163 bit 1** | 137 > 164 | Timer >= 195 High byte | 137 > 162 | Timer >= 195 Low byte |
| **PGA Trigger 163 bit 2** | 104> 121 | Timer >= 195 High byte | 104 >161 | Timer >= 195 Low byte |
| **STA/LTA Trigger 163 bit 3** | 112 = 1 AND 128 >= 117 AND 108 > 123 | Timer >= 120 | 112 = 1 AND 128 >= 117 AND 108 > 124 | Timer >= 120 |

Address 122 – Zero Point Correction Sampling Count

Accelerometers may experience zero-point drift due to factors such as the installation location's horizontal orientation or environmental conditions. Palert is equipped with automatic and scheduled zeroing capabilities. This address stores the number of samples averaged when calculating the zero-point compensation value. The default value is 200. When modifying this address, you must write 2 to Address 113 to apply the new setting.

Address 123 and 124 – DO0 and DO1 Action Point Settings

When an earthquake event is triggered, the Digital Outputs (DO) will be turned ON or OFF based on the configured earthquake event trigger mode. Please refer to the table below for details (values underlined in the table represent addresses).

| | DO0 | | DO1 | |
|---|---|---|---|---|
| **DO Status/Trigger Modes** | ON | OFF | ON | OFF |
| **Displacement Trigger 163 bit 0** | 159 > 197 | Timer >= 195 High byte | 159 > 160 | Timer >= 195 Low byte |
| **Pd Trigger 163 bit 1** | 137 > 164 | Timer >= 195 High byte | 137 > 162 | Timer >= 195 Low byte |
| **PGA Trigger 163 bit 2** | 104> 121 | Timer >= 195 High byte | 104 >161 | Timer >= 195 Low byte |
| **STA/LTA Trigger 163 bit 3** | 112 = 1 AND 128 >= 117 AND 108 > 123 | Timer >= 120 | 112 = 1 AND 128 >= 117 AND 108 > 124 | Timer >= 120 |

Address 125 – Maximum Velocity of Three Axes within One Second

Palert continuously calculates the velocity in three axes, and this address stores the maximum velocity value within one second. The unit is 0.01 cm/s.

Address 126 – Maximum Displacement of Three Axes within One Second

Palert continuously calculates the displacement in three axes, and this address stores the maximum displacement value within one second (after passing through a 0.075Hz high-pass filter). The unit is 0.001 cm.

Address 127 – Last Earthquake Trigger Message

This address stores the trigger message of the last earthquake event, corresponding to the information in Address 111.

Address 128 – Current Value of STA / LTA

The value at this address represents the real-time calculation of STA / LTA. When this value exceeds the set threshold in Address 117, it is considered as an earthquake.

Address 129 – Maximum Acceleration in A-axis during Earthquake Event

During an earthquake event, Palert continuously calculates the maximum vibrations in each axis. This address stores the maximum vibration value in the A-axis that occurred during the current earthquake event. The unit is in counts, with 1 gal equivalent to 16.718 counts.

Address 130 – Maximum Acceleration in B-axis during Earthquake Event

During an earthquake event, Palert continuously calculates the maximum vibrations in each axis. This address stores the maximum vibration value in the B-axis that occurred during the current earthquake event. The unit is in counts, with 1 gal equivalent to 16.718 counts.

Address 131 – Maximum Acceleration in C-axis during Earthquake Event

During an earthquake event, Palert continuously calculates the maximum vibrations in each axis. This address stores the maximum vibration value in the C-axis that occurred during the current earthquake event. The unit is in counts, with 1 gal equivalent to 16.718 counts.

Address 132 – Maximum Acceleration Value of the Composite Vector Vibration in the A-axis during Earthquake Event

During an earthquake event, Palert calculates the maximum vibration value of the three-axis acceleration composite vector in real-time. This address stores the A-axis component value of the maximum composite vector vibration during the current earthquake event. The unit is in counts, with 1 gal equivalent to 16.718 counts.

Address 133 – Maximum Acceleration in B-axis during Earthquake Event

During an earthquake event, Palert continuously calculates the maximum vibrations in each axis. This address stores the B-axis component value of the maximum vibration in the three-axis acceleration composite vector that occurred during the current earthquake event. The unit is in counts, with 1 gal equivalent to 16.718 counts.

Address 134 – Maximum Acceleration Value in C-axis during Earthquake Event

During an earthquake event, Palert continuously calculates the maximum vibrations in each axis. This address stores the C-axis component value of the maximum vibration in the three-axis acceleration composite vector that occurred during the current earthquake event. The unit is in counts, with 1 gal equivalent to 16.718 counts.

Address 135 – Axis Triggered by PGA Event

This address stores the axis triggered by the Peak Ground Acceleration (PGA) event. It is typically 0, and when a PGA earthquake event is triggered, 1 represents triggering in the A-axis, 2 in the B-axis, and 3 in the C-axis. Note that the PGA trigger function (bit 2 of Address 163) must be activated for this function to be effective.

Address 136 – Pv Value in A-axis

This address stores the velocity value in the A-axis after the triggering of the P-wave. This value is obtained by integrating acceleration and is measured in 0.01 cm units.

Address 137 – Pd Value in A-axis

This address stores the Pd (Duration of Preliminary Tremor) value in the A-axis after the triggering of the P-wave. The unit is 0.001 cm. When a P-wave is detected, and the Pd value within 3 seconds exceeds 0.3 cm, it indicates that the subsequent S-wave may be highly destructive. For more information on Pd, please refer to Appendix One.

Address 138 – Tau-c Value in A-axis

This address stores the tau-c value in the A-axis after the triggering of the P-wave. The unit is 0.001 Hz. For more information on tau-c, please refer to Appendix One.

Address 139 – Pd Trigger Status

This address stores the trigger status of the Pd event. For more information on Pd, please refer to Appendix One. Please note that the Pd trigger function (bit 1 of Address 163) must be activated for this function to be effective.

- Bit 4: Detection of P-wave.
- Bit 5: Detection of P-wave.
- Bit 6: Pd value exceeds the caution level.
- Bit 7: Pd value exceeds the warning level.

Address 140 – Maximum PGA Value in 10 Seconds

This address stores the maximum value of PGA within 10 seconds. The unit is count, where one gal is equivalent to 16.718 counts.

Address 141 – Earthquake Event Time Record (Year)

This address records the year of the last earthquake event.

Address 142 – Earthquake Event Time Record (Month)

This address records the month of the last earthquake event.

Address 143 – Earthquake Event Time Record (Day)

This address records the day of the last earthquake event.

Address 144 – Earthquake Event Time Record (Hour)

This address records the hour of the last earthquake event.

Address 145 – Earthquake Event Time Record (Minute)

This address records the minute of the last earthquake event.

Address 146 – Earthquake Event Time Record (Second)

This address records the second of the last earthquake event.

Address 147 – System Time (Year)

This address represents the system's current year.

Address 148 – System Time (Month)

This address represents the system's current month.

Address 149 – System Time (Day)

This address represents the system's current day.

Address 150 – System Time (Hour)

This address represents the system's current hour.

Address 151 – System Time (Minute)

This address represents the system's current minute.

Address 152 – System Time (Second)

This address holds the current second in the system time.

Address 153 – Set System Time (Year)

This address holds the value to set the system time for the year. Although Palert has NTP time synchronization capability, when Address 113 is set to 8, the real-time clock (RTC) of the system will be configured with the time information from Addresses 153 to 158.

Address 154 – Set System Time (Month)

This address holds the value to set the system time for the month. Although Palert has NTP time synchronization capability, when Address 113 is set to 8, the real-time clock (RTC) of the system will be configured with the time information from Addresses 153 to 158.

Address 155 – Set System Time (Day)

This address holds the value to set the system time for the day. Although Palert has NTP time synchronization capability, when Address 113 is set to 8, the real-time clock (RTC) of the system will be configured with the time information from Addresses 153 to 158.

Address 156 – Set System Time (Hour)

This address holds the value to set the system time for the hour. Although Palert has NTP time synchronization capability, when Address 113 is set to 8, the real-time clock (RTC) of the system will be configured with the time information from Addresses 153 to 158.

Address 157 – Set System Time (Minute)

This address holds the value to set the system time for the minute. Although Palert has NTP time synchronization capability, when Address 113 is set to 8, the real-time clock (RTC) of the system will be configured with the time information from Addresses 153 to 158.

Address 158 – Set System Time (Second)

This address holds the value to set the system time for the second. Although Palert has NTP time synchronization capability, when Address 113 is set to 8, the real-time clock (RTC) of the system will be configured with the time information from Addresses 153 to 158.

Address 159 – Real-time Displacement for Axis a

This address stores the real-time displacement for axis a. The real-time displacement is obtained through double integration of acceleration and is filtered by a 0.075Hz high-pass filter. The unit is 0.001 cm.

Address 160 – Warning Level for Displacement on Axis a

This address stores the warning level for displacement on axis a, with a unit of 0.001 cm. The recommended setting is 0.35 cm. When bit 0 of Address 163 is set to 1 and the real-time displacement value at Address 159 exceeds this set value, it indicates an earthquake event trigger. After the event trigger, refer to the table below for the actions of DO, and bit 0 of Address 111 will be set to 1.

| | DO0 | | DO1 | |
|---|---|---|---|---|
| **DO Status/Trigger Modes** | ON | OFF | ON | OFF |
| **Displacement Trigger 163 bit 0** | 159 > 197 | Timer >= 195 High byte | 159 > 160 | Timer >= 195 Low byte |
| **Pd Trigger 163 bit 1** | 137 > 164 | Timer >= 195 High byte | 137 > 162 | Timer >= 195 Low byte |
| **PGA Trigger 163 bit 2** | 104> 121 | Timer >= 195 High byte | 104 >161 | Timer >= 195 Low byte |
| **STA/LTA Trigger 163 bit 3** | 112 = 1 AND 128 >= 117 AND 108 > 123 | Timer >= 120 | 112 = 1 AND 128 >= 117 AND 108 > 124 | Timer >= 120 |

Address 161 – Setting for PGA Warning Level

This address stores the setting for the PGA (Peak Ground Acceleration) warning level, with the unit in counts. The recommended setting is 1337 counts (80 gals). When bit 2 of Address 163 is set to 1 and the PGA value exceeds this set value, it indicates an earthquake event trigger. After the event trigger, refer to the table below for the actions of DO, and bit 2 of Address 111 will be set to 1.

| | DO0 | | DO1 | |
|---|---|---|---|---|
| **DO Status/Trigger Modes** | ON | OFF | ON | OFF |
| **Displacement Trigger 163 bit 0** | 159 > 197 | Timer >= 195 High byte | 159 > 160 | Timer >= 195 Low byte |
| **Pd Trigger 163 bit 1** | 137 > 164 | Timer >= 195 High byte | 137 > 162 | Timer >= 195 Low byte |
| **PGA Trigger 163 bit 2** | 104> 121 | Timer >= 195 High byte | 104 >161 | Timer >= 195 Low byte |
| **STA/LTA Trigger 163 bit 3** | 112 = 1 AND 128 >= 117 AND 108 > 123 | Timer >= 120 | 112 = 1 AND 128 >= 117 AND 108 > 124 | Timer >= 120 |

Address 162 – Setting for Pd Warning Level

This address stores the setting for the Pd (P-wave displacement) warning level, with the unit in 0.001 cm. The recommended setting is 0.35 cm. When bit 1 of Address 163 is set to 1 and the real-time Pd value of a-axis at Address 137 exceeds this set value, it indicates an earthquake event trigger. After the event trigger, refer to the table above for the actions of DO, and bit 1 of Address 111 will be set to 1.

Address 163 – Low-Pass Filter and Trigger Mode Setting

Palert provides four earthquake trigger logic options, with Pd and PGA triggers recommended.

- bit 0: Displacement Trigger Mode Setting
- bit 1: Pd Trigger Mode Setting
- bit 2: PGA Trigger Mode Setting
- bit 3: STA/LTA Trigger Mode Setting
- bit 7: Low-Pass Filter Selection (0 for 10Hz, 1 for 20Hz).

The earthquake trigger modes, except for STA/LTA, can immediately detect earthquakes after automatic zeroing calibration following startup. When modifying this address, write 2 to Address 113 to apply the changes.

Address 164 – Pd Warning Level Setting

This address stores the Pd warning level, with the unit in 0.001 cm. The recommended setting is 0.2 cm. When bit 1 of Address 163 is set to 1 and the real-time Pd value of a-axis at Address 137 exceeds this set value, it indicates a seismic warning event trigger. After the warning event trigger, refer to the table below for the actions of DO, and bit 1 of Address 111 will be set to 1.

| | DO0 | | DO1 | |
|---|---|---|---|---|
| **DO Status/Trigger Modes** | ON | OFF | ON | OFF |
| **Displacement Trigger 163 bit 0** | 159 > 197 | Timer >= 195 High byte | 159 > 160 | Timer >= 195 Low byte |
| **Pd Trigger 163 bit 1** | 137 > 164 | Timer >= 195 High byte | 137 > 162 | Timer >= 195 Low byte |
| **PGA Trigger 163 bit 2** | 104> 121 | Timer >= 195 High byte | 104 >161 | Timer >= 195 Low byte |
| **STA/LTA Trigger 163 bit 3** | 112 = 1 AND 128 >= 117 AND 108 > 123 | Timer >= 120 | 112 = 1 AND 128 >= 117 AND 108 > 124 | Timer >= 120 |

Address 165 – Calibration Coefficient for a-Axis at 0g

Palert is calibrated at the factory, and it is not recommended for users to modify or adjust it themselves. This address represents the zero-point calibration coefficient for the accelerometer's a-axis. The calibration process is as follows:

1. Write 0 to the address and force the system to initialize.
2. Place the a-axis horizontally on the ground and note the offset value for the a-axis.
3. If the offset value is, for example, 10.2 mg, write 102 to the address and force the system to initialize again. At this point, the offset value for the a-axis should be close to 0g.

Note: Executing this action may potentially trigger seismic signals, so it is essential to ensure the system is offline before proceeding.

Address 166 – Calibration Coefficient for b-Axis at 0g

Palert is calibrated at the factory, and it is not recommended for users to modify or adjust it themselves. This address represents the zero-point calibration coefficient for the accelerometer's b-axis. The calibration process is as follows:

1. Write 0 to the address and force the system to initialize.
2. Place the b-axis horizontally on the ground and note the offset value for the b-axis.
3. If the offset value is, for example, 10.2 mg, write 102 to the address and force the system to initialize again. At this point, the offset value for the b-axis should be close to 0g.

Note: Executing this action may potentially trigger seismic signals, so it is essential to ensure the system is offline before proceeding.

Address 167 – Calibration Coefficient for c-Axis at 0g

Palert is calibrated at the factory, and it is not recommended for users to modify or adjust it themselves. This address represents the zero-point calibration coefficient for the accelerometer's c-axis. The calibration process is as follows:

1. Write 0 to the address and force the system to initialize.
2. Place the c-axis horizontally on the ground and note the offset value for the c-axis.
3. If the offset value is, for example, 10.2 mg, write 102 to the address and force the system to initialize again. At this point, the offset value for the c-axis should be close to 0g.

Note: Executing this action may potentially trigger seismic signals, so it is essential to ensure the system is offline before proceeding.

Address 168 – Calibration Coefficient for a-Axis at 1g

Palert is calibrated at the factory, and it is not recommended for users to modify or adjust it themselves. This address represents the calibration coefficient for the accelerometer's a-axis when subjected to 1g.

The calibration process is as follows:

1. Write 10000 to the address and force the system to initialize.
2. Place the a-axis vertically (perpendicular) to the ground and note the offset value for the a-axis.
3. If the offset value is, for example, 1010.5 mg, write 10105 to the address and force the system to initialize again. At this point, the offset value for the a-axis should be close to 1g.

Note: Executing this action may potentially trigger seismic signals, so it is essential to ensure the system is offline before proceeding.

Address 169 – Calibration Coefficient for b-Axis at 1g

Palert is calibrated at the factory, and it is not recommended for users to modify or adjust it themselves. This address represents the calibration coefficient for the accelerometer's b-axis when subjected to 1g.

The calibration process is as follows:

1. Write 10000 to the address and force the system to initialize.
2. Place the b-axis vertically (perpendicular) to the ground and note the offset value for the b-axis.
3. If the offset value is, for example, 1010.5 mg, write 10105 to the address and force the system to initialize again. At this point, the offset value for the b-axis should be close to 1g.

Note: Executing this action may potentially trigger seismic signals, so it is essential to ensure the system is offline before proceeding.

Address 170 – Calibration Coefficient for c-Axis at 1g

Palert is calibrated at the factory, and it is not recommended for users to modify or adjust it themselves. This address represents the calibration coefficient for the accelerometer's c-axis when subjected to 1g.

The calibration process is the same as described for Address 169. The steps involve writing 10000 to the address, initializing the system, placing the c-axis vertically, noting the offset value, and then writing an adjusted value (e.g., 10105) to the address and initializing the system again.

Note: Executing this action may potentially trigger seismic signals, so it is essential to ensure the system is offline before proceeding.

Address 171-174 – NTP Network Time Server IP Address Configuration

Palert is equipped with NTP time synchronization functionality, and this address range stores information about the NTP server's network address. When bit 4 of Address 118 is set to 1, Palert attempts to connect with the NTP time server every 10 minutes. After making changes to this address range, the user must write to Address 113 with a value of 2 to apply the changes.

If Palert cannot synchronize time with the specified NTP server at this address, it uses TCP Server 0 and TCP Server 1 as backup NTP servers.

Address 175 – Day of the Week

This address represents the day of the week (1 to 7) in the system's date.

Address 176-177 – TCP Server 0 Network Address Configuration

Palert features Modbus TCP Client functionality. When bit 3 of Address 118 is set to 1, Palert attempts to establish a connection with TCP Server 0 until a successful connection is established. The status of the connection, whether successful or not, is stored in bit 1 of Address 100. This address range stores the network information for Server 0 (Address 176 high byte, Address 176 low byte, Address 177 high byte, Address 177 low byte).

If the user wishes to change the network address of Server 0, they must not only modify this address range but also set Address 113 to 18. This action enables the reactivation and initialization of Palert with the new network address data. Please refer to the instructions for setting Address 113 (default: 192.168.255.2).

Address 178-179 – TCP Server 1 Network Address Configuration

Palert is equipped with Modbus TCP Client functionality. When bit 6 of Address 118 is set to 1, Palert attempts to establish a connection with TCP Server 1 until a successful connection is established. The status of the connection, whether successful or not, is stored in bit 2 of Address 100. This address range stores the network information for Server 1 (Address 178 high byte, Address 178 low byte, Address 179 high byte, Address 179 low byte).

If the user wishes to change the network address of Server 1, they must not only modify this address range but also set Address 113 to 18. This action enables the reactivation and initialization of Palert with the new network address data. Please refer to the instructions for setting Address 113.

Server 1 also serves as the IP for the FTP server. When Address 113 is set to 0x180, Palert attempts to use the IP of Server 1 as the FTP Server to try updating the firmware.

Address 180-191 – Palert Network Address Configuration

This address range stores the network information for Palert. Addresses 180-183 represent the IP Address, 184-187 represent the Subnet Mask, and 188-191 represent the Gateway. The default IP settings at the factory are 192.168.255.1, 255.255.0.0, and 192.168.0.1.

If the user wishes to change the network address of Palert, they must not only modify addresses 180-191 but also set Address 113 to 4. This action writes the data to the EEPROM and initializes Palert. Please refer to the instructions for setting Address 113.

If the user inadvertently sets the network information incorrectly and doesn't know the IP address of Palert, they can short DI0 to ground. At this point, Palert's LED will display its IP address (Note: Palert should remain in a non-triggered state).

Address 192 – Remaining TCP Socket Count

This address represents the remaining number of hosts that Palert can simultaneously connect to using TCP sockets. The value at this address indicates the remaining available connections. Note that modifying this address is ineffective.

Address 193 – Streaming Data Output Mode Control

When writing 1 or 2 to this address using the Modbus TCP protocol, Palert acknowledges the command in the standard Modbus format. Subsequently, Palert sends relevant information at a rate of one data packet per second. It sends a packet after detecting the P-wave and another one three seconds later. When the Pd trigger mode is activated, if the Pd value exceeds the watch or warning levels, Palert immediately sends an additional packet. The format of the sent packets depends on the value written as 1 or 2. The content of the streaming data is not in the Modbus format, so the host must be prepared to receive this streaming data separately. It's advisable not to use this command for PLCs that only have pure Modbus functionality. To stop streaming data output, write 0 to this address.

| Mode 1 | Mode 2 | Integer Number | Description (Value in parentheses indicate Palert Modbus registers addresses) |
|---|---|---|---|
| ▲ | ▲ | 0 | Packet type<br>1: Normal streaming packet<br>119: P wave streaming packet<br>300: Pd within 3 seconds after P wave<br>1191: Pd watch streaming packet<br>1192: Pd warning streaming packet |
| ▲ | ▲ | 1 | Event flag (111) |
| ▲ | ▲ | 2 | system time-year (147) |
| ▲ | ▲ | 3 | system time-month (148) |
| ▲ | ▲ | 4 | system time-day (149) |
| ▲ | ▲ | 5 | system time-hour (150) |
| ▲ | ▲ | 6 | system time-minute (151) |

| Mode 1 | Mode 2 | Integer Number | Description (Value in parentheses indicate Palert Modbus registers addresses) |
|---|---|---|---|
| ▲ | ▲ | 7 (high byte) | system time-second (152) |
| ▲ | ▲ | 7 (low byte) | system time-10 msecond |
| ▲ | ▲ | 8 | event time-year (141) |
| ▲ | ▲ | 9 | event time-month (142) |
| ▲ | ▲ | 10 | event time-day (143) |
| ▲ | ▲ | 11 | event time-hour (144) |
| ▲ | ▲ | 12 | event time-minute (145) |
| ▲ | ▲ | 13 (high byte) | event time-second (146) |
| ▲ | ▲ | 13 (low byte) | event time-10 msecond |
| ▲ | ▲ | 14 | Serial number (200) |
| ▲ | ▲ | 15 | Displacement watch threshold (197) |
| ▲ | ▲ | 16 | PGV within 1 second (125) |
| ▲ | ▲ | 17 | PGD within 1 second (126) |
| ▲ | ▲ | 18 | PGA within 10 seconds (140) |
| ▲ | ▲ | 19 | PGA trig axis (135) |
| ▲ | ▲ | 20 | Pd warning threshold (162) |
| ▲ | ▲ | 21 | PGA warning threshold (161) |
| ▲ | ▲ | 22 | Displacement warning threshold (160) |
| ▲ | ▲ | 23 | Pd flag (139) |
| ▲ | ▲ | 24 | Pd watch threshold (164) |
| ▲ | ▲ | 25 | PGA watch threshold (121) |
| ▲ | ▲ | 26 | Intensity now (109) |
| ▲ | ▲ | 27 | Intensity maximum (110) |
| ▲ | ▲ | 28 | PGA within 1 second |
| ▲ | ▲ | 29 | PGA axis within 1 second |
| ▲ | ▲ | 30 | tau-c (138) |

| Mode 1 | Mode 2 | Integer Number | Description (Value in parentheses indicate Palert Modbus registers addresses) |
|---|---|---|---|
| ▲ | ▲ | 31 | Trig mode (163) |
| ▲ | ▲ | 32 | Operation Mode (118) |
| ▲ | ▲ | 33 | Durations for watch and warning (195) |
| ▲ | ▲ | 34 | Firmware version |
| ▲ | ▲ | 35 ~ 38 | IP Address (180~183) |
| ▲ | ▲ | 39 ~ 40 | Server 0 IP address (176~177) |
| ▲ | ▲ | 41 ~ 42 | Server 1 IP address (178~179) |
| ▲ | ▲ | 43 ~ 46 | NTP server IP address (171~174) |
| ▲ | ▲ | 47 | Sockets remain (192) |
| ▲ | ▲ | 48 | Connection flag (100) |
| ▲ | ▲ | 49 | D I/O status (119) |
| ▲ | ▲ | 50 | EEW register (198) |
| ▲ | ▲ | 51 | Pd in vertical axis (137) (0.001cm) |
| ▲ | ▲ | 52 | Pv in vertical axis (136) (0.01cm/sec) |
| ▲ | ▲ | 53 | Pa in vertical axis (counts/sec^2) |
| ▲ | ▲ | 54 | Maximum vector in earthquake (108) |
| ▲ | ▲ | 55 | Maximum a axis acceleration in earthquake (129) |
| ▲ | ▲ | 56 | Maximum b axis acceleration in earthquake (130) |
| ▲ | ▲ | 57 | Maximum c axis acceleration in earthquake (131) |

| Mode 1 | Mode 2 | Integer Number | Description (Value in parentheses indicate Palert Modbus registers addresses) |
|---|---|---|---|
| ▲ | ▲ | 58 | Maximum a axis acceleration of vector in earthquake (132) |
| ▲ | ▲ | 59 | Maximum b axis acceleration of vector in earthquake (133) |
| ▲ | ▲ | 60 | Maximum c axis acceleration of vector in earthquake (134) |
| ▲ | ▲ | 61 ~69 | Reserved |
| ▲ | ▲ | 70 | Synchronized Character 0x3033 |
| ▲ | ▲ | 71 | Synchronized Character 0x3035 |
| ▲ | ▲ | 72 | Synchronized Character 0x3135 |
| ▲ | ▲ | 73 | Synchronized Character 0x3031 |
| ▲ | ▲ | 74 | Packet Length |
| ▲ | ▲ | 75 | EEWS DO0 Intensity (202) |
| ▲ | ▲ | 76 | EEWS DO1 Intensity (203) |
| ▲ | ▲ | 77~78 | FTE-D04 IP address (204~205) |
| ▲ | ▲ | 79 | opModeX (208) |
| ▲ | ▲ | 80 | Whitelist 1, IP1, 2 (209) |
| ▲ | ▲ | 81 | Whitelist 1, IP3, 4 (210) |
| ▲ | ▲ | 82 | Whitelist 2, IP1, 2 (211) |

| Mode 1 | Mode 2 | Integer Number | Description (Value in parentheses indicate Palert Modbus registers addresses) |
|---|---|---|---|
| ▲ | ▲ | 82 | Whitelist 2, IP1, 2 (211) |
| ▲ | ▲ | 83 | Whitelist 2, IP3, 4 (212) |
| ▲ | ▲ | 84 | Whitelist 3, IP1, 2 (213) |
| ▲ | ▲ | 85 | Whitelist 3, IP3, 4 (214) |
| ▲ | ▲ | 86 | Maximum vector velocity (273) |
| ▲ | ▲ | 87~92 | Reserved |
| ▲ | ▲ | 93 | CRC* |
| ▲ | ▲ | 84~95 | Reserved |
| ▲ | ▲ | 99 | Sampling Rate |
| ▲ | | 100 | a axis Acceleration of Record 1 |
| ▲ | | 101 | b axis Acceleration of Record 1 |
| ▲ | | 102 | c axis Acceleration of Record 1 |
| ▲ | | 103 | Pd of Record 1 |
| ▲ | | 104 | Displacement of Record 1 |
| ▲ | | .. | .. |
| ▲ | | 595 | a axis Acceleration of Record 100 |
| ▲ | | 596 | b axis Acceleration of Record 100 |
| ▲ | | 597 | c axis Acceleration of Record 100 |
| ▲ | | 598 | Pd of Record 100 |
| ▲ | | 599 | Displacement of Record 100 |

Note:

1. The integer format of streaming data is in little-endian order, with the low byte first and the high byte later.
2. Streaming functionality is only available when using Modbus TCP.
3. Due to the length limitation of streaming packets, CRC verification has been added. The CRC is calculated based on the original 1200-byte packet (with the integer number 93 position set to 0), and the calculated CRC is then stored in the integer number 93 position.

Address 194: Modbus RTU Address Setting

The default value is 101, and users can modify it based on their needs within the range of 1 to 255. When this address is modified, it is necessary to write to address 113 with the value 2 to make this setting effective.

Address 195: Warning and Alert Duration

This address stores the duration settings for the warning (Watch) and alert (Warning) times for Pd, PGA, and displacement trigger modes. The high byte represents the duration in seconds for warning (recommended value: 10 seconds), and the low byte represents the duration in seconds for the alert (recommended value: 30 seconds). Regarding the actions of the digital outputs (DO), please refer to the explanation in the table (values underlined in the table represent addresses). When this address is modified, it is necessary to write to address 113 with the value 2 to make this setting effective.

| | DO0 | | DO1 | |
|---|---|---|---|---|
| **DO Status/Trigger Modes** | ON | OFF | ON | OFF |
| **Displacement Trigger 163 bit 0** | 159 > 197 | Timer >= 195 High byte | 159 > 160 | Timer >= 195 Low byte |
| **Pd Trigger 163 bit 1** | 137 > 164 | Timer >= 195 High byte | 137 > 162 | Timer >= 195 Low byte |
| **PGA Trigger 163 bit 2** | 104> 121 | Timer >= 195 High byte | 104 >161 | Timer >= 195 Low byte |
| **STA/LTA Trigger 163 bit 3** | 112 = 1 AND 128 >= 117 AND 108 > 123 | Timer >= 120 | 112 = 1 AND 128 >= 117 AND 108 > 124 | Timer >= 120 |

Address 196: Maximum Vibration Value in One Second

This address stores the maximum vibration value within one second, measured in gal.

Address 197: Warning Displacement for Axis A

This position stores the warning displacement level setting for axis A, with a unit of 0.001 cm. The recommended setting is 0.2 cm. When bit 0 of address 163 is set to 1 and the instantaneous displacement value at address 159 is greater than this setting, it indicates the triggering of an earthquake warning event. After the event is triggered, refer to the table for the explanation of the actions of the digital outputs (values underlined in the table represent addresses).

| | DO0 | | DO1 | |
|---|---|---|---|---|
| **DO Status/Trigger Modes** | ON | OFF | ON | OFF |
| **Displacement Trigger 163 bit 0** | 159 > 197 | Timer >= 195 High byte | 159 > 160 | Timer >= 195 Low byte |
| **Pd Trigger 163 bit 1** | 137 > 164 | Timer >= 195 High byte | 137 > 162 | Timer >= 195 Low byte |
| **PGA Trigger 163 bit 2** | 104> 121 | Timer >= 195 High byte | 104 >161 | Timer >= 195 Low byte |
| **STA/LTA Trigger 163 bit 3** | 112 = 1 AND 128 >= 117 AND 108 > 123 | Timer >= 120 | 112 = 1 AND 128 >= 117 AND 108 > 124 | Timer >= 120 |

Address 198: Regional Earthquake Warning Register

This address serves as a register to receive earthquake warning information from the earthquake server. The high byte represents the seismic intensity, and the low byte represents the expected arrival time of the seismic wave. If adopting the new seismic intensity classification standard by the Central Weather Bureau (CWB), the values in this position correspond to the seismic intensity as follows:

| Intensity | 1 | 2 | 3 | 4 | 5 weak | 5 strong | 6 weak | 6 strong | 7 |
|---|---|---|---|---|---|---|---|---|---|
| Value | 10 | 20 | 30 | 40 | 51 | 59 | 61 | 69 | 70 |

When this address is filled with earthquake information, two Digital Outputs (DO) will determine whether to turn ON or OFF based on the actions for seismic intensity specified in addresses 202 and 203. Simultaneously, the seven-segment display LED will show the seismic intensity and countdown seconds. If a local earthquake occurs during this time, it will immediately switch to local earthquake information.

Additionally, if the device is connected to the FTE-D04 earthquake warning device, the earthquake warning will be synchronized and sent to the FTE-D04 to trigger the alarm.

Note: The FTE-D04 has been discontinued since 2019 and does not support the new seismic intensity classification standard by the Central Weather Bureau (CWB). If there is a need for an earthquake warning alarm, you can contact the sales representative at Sanlien Technology for information about the Cube Earthquake Warning Alarm.

It's important to mention that this functionality requires collaboration with earthquake scientists possessing earthquake warning technology. Moreover, compliance with earthquake information regulations in various countries is necessary.

Since January 1, 2014, Sanlien Technology can provide earthquake warning information provided by the Central Weather Bureau in Taiwan. For related services, please contact the sales representative at Sanlien Technology for further explanation and support.

Address 199 - Palert Software Version:

This address provides read-only access to the Palert software version. Modifications to this address are not allowed.

Address 200 - Palert Machine Serial Number:

This address stores the serial number of the Palert machine. Users can modify this value based on their needs within the range of 1 to 65535. When changes are made to this address, the user must write to address 113 with a value of 2 to ensure that the new setting takes effect.

Address 201 - Modbus RTU Port Setting:

This address stores the configuration for the Modbus RTU port. Users can set it to 1 or 2 based on their requirements. The default factory setting is 2. When changes are made to this address, the user must write to address 113 with a value of 2 to ensure that the new setting takes effect.

Address 202 - Local Earthquake Early Warning DO0 Action Intensity Setting:

When address 198 (Local Earthquake Early Warning Temporary Register) is written with earthquake warning information, DO0 will turn ON or OFF based on the seismic intensity stored in this address. When changes are made to this address, the user must write to address 113 with a value of 2 to save this setting in memory. If using the new CWB seismic intensity classification standard, the values corresponding to intensity are as follows:

| Intensity | 1 | 2 | 3 | 4 | 5 weak | 5 strong | 6 weak | 6 strong | 7 |
|---|---|---|---|---|---|---|---|---|---|
| Value | 10 | 20 | 30 | 40 | 51 | 59 | 61 | 69 | 70 |

Address 203 - Local Earthquake Early Warning DO1 Action Intensity Setting:

When address 198 (Local Earthquake Early Warning Temporary Register) is written with earthquake warning information, DO1 will turn ON or OFF based on the seismic intensity stored in this address. When changes are made to this address, the user must write to address 113 with a value of 2 to save this setting in memory. If using the new CWB seismic intensity classification standard, the values corresponding to intensity are as follows:

| Intensity | 1 | 2 | 3 | 4 | 5 weak | 5 strong | 6 weak | 6 strong | 7 |
|---|---|---|---|---|---|---|---|---|---|
| Value | 10 | 20 | 30 | 40 | 51 | 59 | 61 | 69 | 70 |

Addresses 204-205 - FTE-D04 Network Address Setting:

Palert has the capability to connect to the earthquake early warning alert device FTE-D04. When bit 8 of address 118 is set to 1, Palert will actively establish a connection with FTE-D04. The success or failure of the connection status will be stored in bit 4 of address 100. This group of addresses (204 high byte, 204 low byte, 205 high byte, 205 low byte) stores the network information for FTE-D04. If the user wishes to change the network address for FTE-D04, they must modify this group of addresses and set address 113 to 18 to enable the reinitialization of network address data in Palert. Refer to the explanation for address 113 for details.

Address 206 - Installation Angle:

This address stores the angle of installation, specifically the angle of the B-axis with respect to the North direction, measured in a clockwise direction. When this address is modified, the user must write address 113 with a value of 2 to ensure that this setting is stored in memory.

Address 207 - Dynamic Zero Setting:

Bit 0: On power-up, zero setting.

Bit 1: Dynamic zero tracking before the low-pass filter.

Bit 2: Dynamic zero tracking after the low-pass filter.

When this address is modified, the user must write address 113 with a value of 2 to ensure that this setting is stored in memory.

Address 208 - opModeX, Extended Operation Mode Setting:

Bit 0: Network whitelist access control.

Bit 1: Flat installation, swap A and C axes.

Bit 2: CWB2019 seismic intensity scale.

Bit 3: If using HAZUS functionality, setting this position to 1 will increase the time synchronization frequency to 1 minute per synchronization.

Bit 4: Added control for Mode 2 output points in firmware 2118. If set to 1, Mode 2 packets will be received during device triggering.

When this address is modified, the user must write address 113 with a value of 2 to ensure that this setting is stored in memory.

Addresses 209-210 - Network Whitelist 1:

When bit 0 of address 208 is set to 1, the device only allows access from IPs in the network whitelist. Address 209 represents the high word, and address 210 represents the low word. When the lowest byte is 0, it indicates that the Class C network segment is whitelisted.

For example, setting 10.0.0.216 as the first whitelist entry:

Address 209: 01 02 00 00 00 06 01 06 00 d0 00 0a

Address 210: 01 02 00 00 00 06 01 06 00 d1 d8 00

When this address is modified, the user must write address 113 with a value of 2 to ensure that this setting is stored in memory.

Addresses 211-212, 213-214 - Network Whitelists 2 and 3:

These addresses function similarly to Network Whitelist 1 (addresses 209-210).

Address 273 - Maximum Composite Velocity:

When bit 2 of address 208 is set to 1, this address stores the maximum composite velocity value for all three axes. The unit is 0.1 mm/sec.

Address 274 - Velocity Trigger Warning Level:

When bit 2 of address 208 is set to 1, this address stores the velocity trigger warning level. If the velocity value from address 273 exceeds this set value (unit: 0.01 mm/sec), it triggers the action of DO0. Changes to this address must be confirmed by writing to address 113 with a value of 2.

Address 275 - Velocity Trigger Alert Level:

When bit 2 of address 208 is set to 1, this address stores the velocity trigger alert level. If the velocity value from address 273 exceeds this set value (unit: 0.01 mm/sec), it triggers the action of DO1. Changes to this address must be confirmed by writing to address 113 with a value of 2.

Address 300 - Self-Test:

When a value is written to this address, the output of all three axes will be increased by the specified value (unit: count). This adjustment will persist for a duration of 5 seconds.

## 4.3. Modbus Communication Overview

Palert supports Modbus Function Codes 1, 2, 3, 6, and 16. Here's a brief explanation:

Function Code 1 (Read Coils):

- Used to read the status of coils (binary outputs) in the Palert.

Function Code 2 (Read Discrete Inputs):

- Used to read the status of discrete inputs (binary inputs) in the Palert.

Function Code 3 (Read Holding Registers):

- Used to read the contents of holding registers in the Palert.

Function Code 6 (Write Single Register):

- Used to write a single holding register in the Palert. This allows for setting specific parameters.

Function Code 16 (Write Multiple Registers):

- Used to write multiple holding registers in the Palert. This is efficient for setting multiple parameters in a single command.

Palert supports both Modbus TCP and Modbus RTU. In Modbus TCP, the Modbus address is always 1. In Modbus RTU, the default Modbus address is 101. Communication settings for Modbus RTU are 19200, 8, N, 1. If users need to change the Modbus RTU address, the Modbus register address 40194 can be used for configuration.

Example: Setting STA Time Duration to 2.5 seconds using Modbus TCP (Function Code 6):

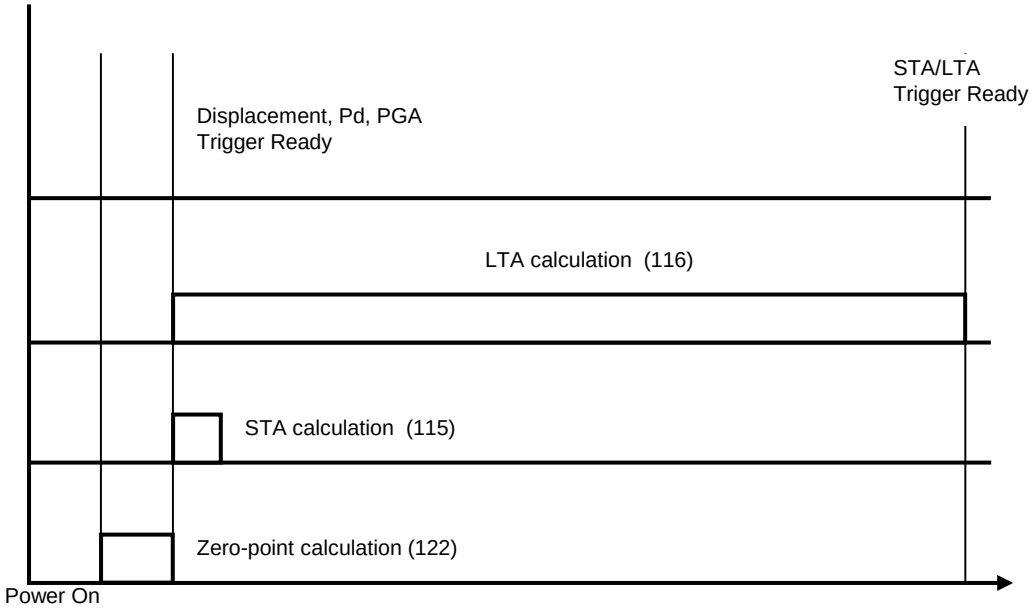
- Desired Time: 2.5 seconds (25 * 0.1 seconds)
- Modbus Register Address: 40115 (0x0072 in Palert, 0-based)
- Modbus Function Code: 6 (Write Single Register)
- Modbus Data: 0x0019 (25 in decimal)

| TID (hex) | PID (hex) | Field Length (hex) | UID (hex) | FC (hex) | Reg_Offset. (hex) | Value (hex) |
|---|---|---|---|---|---|---|
| 0001 | 0000 | 0006 | 01 | 06 | 0072 | 0019 |

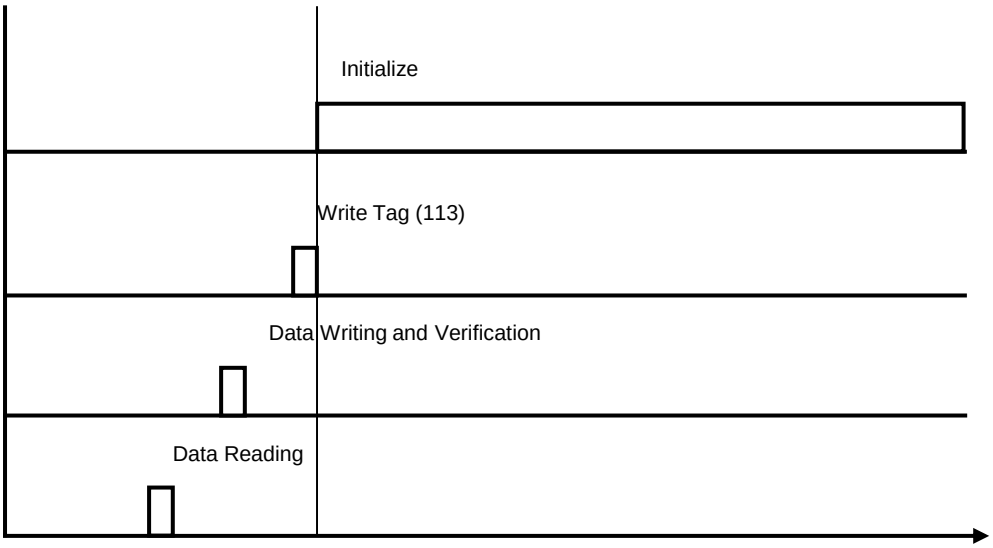
- TID: Transaction Identifier
- PID: Protocol Identifier (Protocol Length)
- UID: Unit Identifier
- FC: Function Code

## 4.4. Palert Operation Timing Diagram

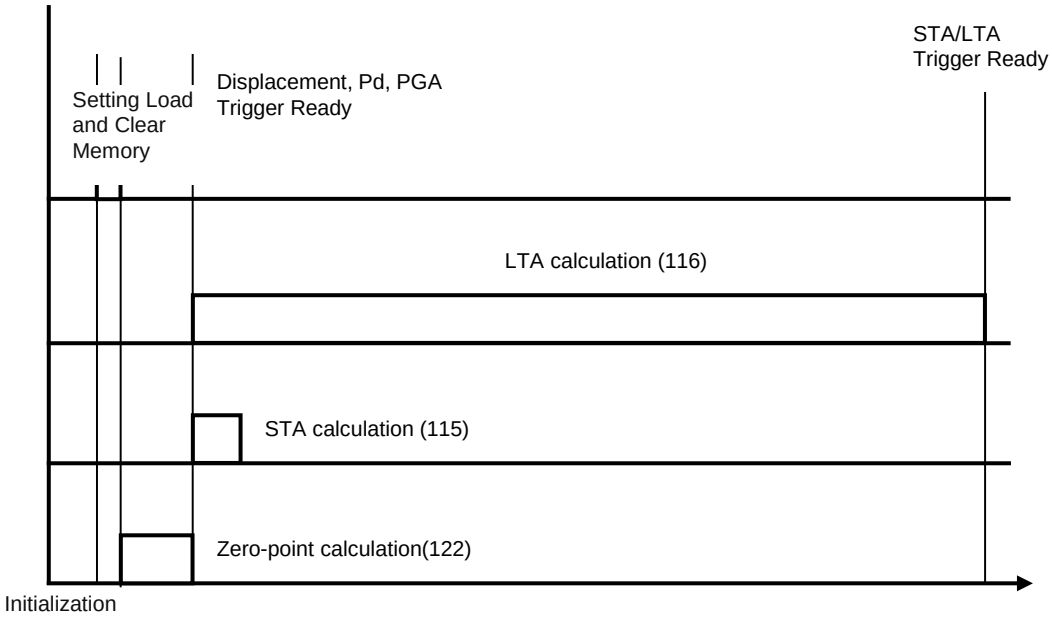
### 4.4.1. Startup Timing Diagram



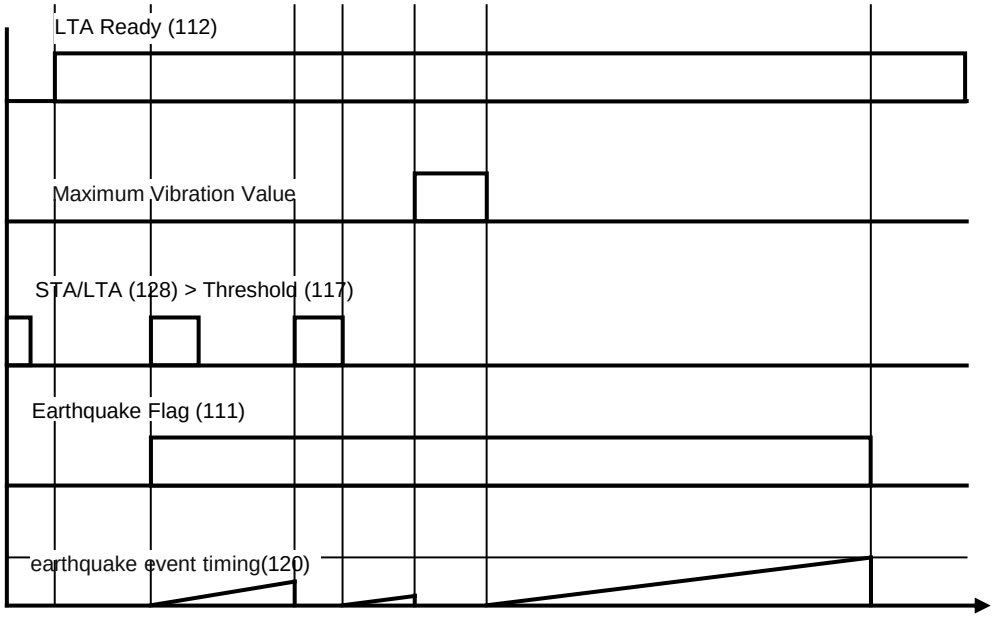

### 4.4.2. Parameter Setting Timing Diagram



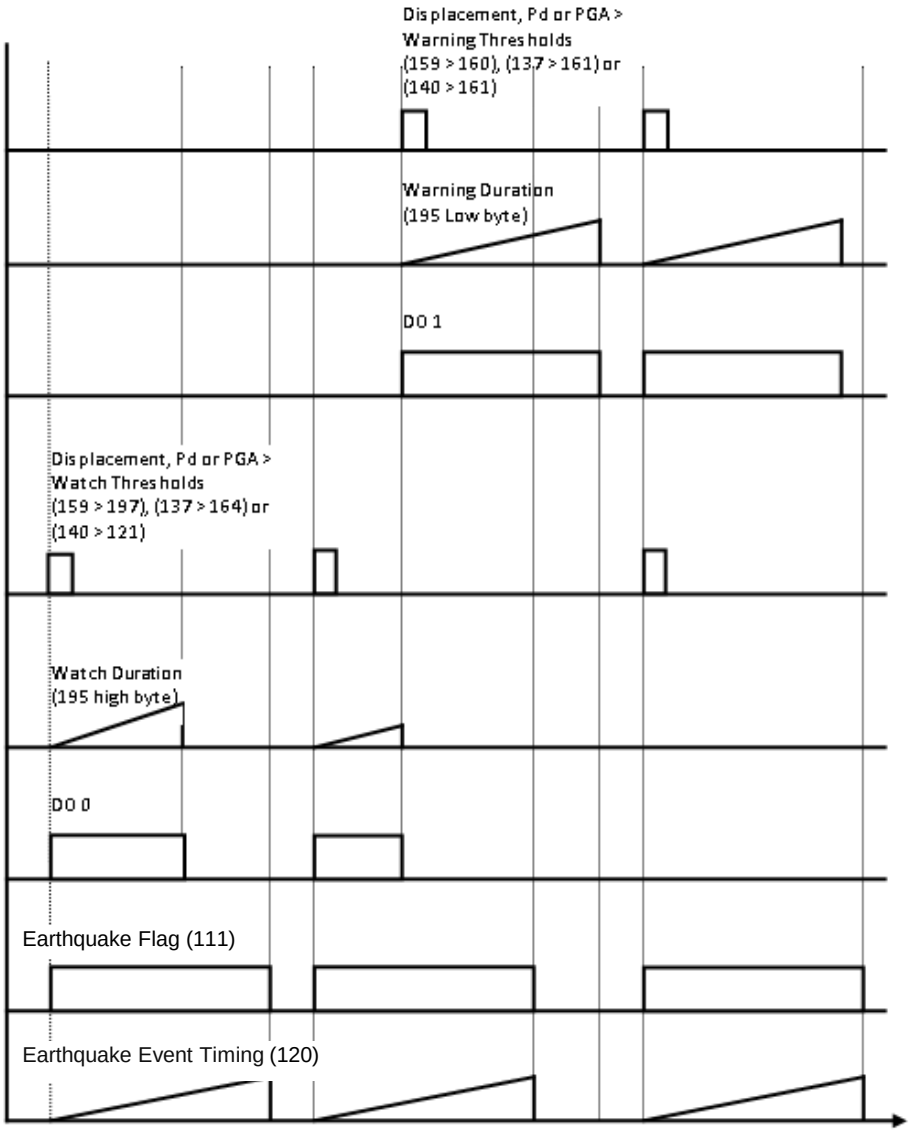
### 4.4.3. Initialization Timing Diagram




### 4.4.4. STA/LTA Discrimination Mode Earthquake Event Timing Diagram



### 4.4.5. Displacement, Pd, and PGA Discrimination Mode Earthquake Event Timing Diagram



# Appendix One: Central Weather Bureau Old Seismic Intensity Classification Standards

Ministry of Transportation Central Weather Bureau Earthquake Intensity Classification Table (Revised on August 1, 2000 of the Republic of China)

| Intensity Classification | | Range of Ground Acceleration | Personal Sensation | Indoor Situation | Outdoor Situation |
|---|---|---|---|---|---|
| 0 | No sensation | Below 0.8gal | People do not feel anything | | |
| 1 | Microseismic | 0.8~2.5 gal | People can feel slight shaking when stationary | | |
| 2 | Light Earthquake | 2.5~8.0gal | Most people can feel shaking, and some sleeping individuals may wake up | Hanging objects like lamps may sway slightly. | Parked cars might rock gently, similar to the sensation of a passing truck, but it is brief. |
| 3 | Minor Earthquake | 8~25gal | Almost everyone feels shaking, and some may experience fear. | Houses shake, dishes rattle, and doors and windows may make noise. | Parked cars noticeably rock, and power lines may sway slightly. |
| 4 | Light Earthquake | 25~80gal | There is a considerable level of fear, and some people may seek refuge. People who are sleeping are almost always awakened. | Houses shake severely, unstable objects may topple, and heavier furniture can move. There may be minor disasters. | Motorists may feel a slight sensation, power lines sway noticeably, and pedestrians feel the shaking. |
| 5 | Strong Earthquake | 80~250gal | Most people will feel scared and panicked. | Some walls may develop cracks, and heavy furniture may overturn. | |

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| Intensity Classification | | Range of Ground Acceleration | Personal Sensation | Indoor Situation | Outdoor Situation |
|---|---|---|---|---|---|
| 6 | Violent Earthquake | 250~400gal | Violent shaking makes it difficult to stand | Some buildings are damaged, heavy furniture overturns, and doors and windows may warp. | Drivers may find it difficult to drive, and there may be sand and mud ejection. |
| 7 | Severe Earthquake | 400 gal Above | Violent shaking makes it impossible to move at will. | Some buildings are severely damaged or collapsed, almost all furniture is significantly displaced or falls to the ground. | Landslides and ground ruptures may occur, railway tracks may bend, and underground pipelines may be damaged. |
| Note: 1gal = 1cm/sec$^2$ | | | | | |

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# Appendix Two: Central Weather Bureau Current Seismic Intensity Classification Standard (Implemented on January 1, 2020)

Seismic Intensity Ranging of Ground Acceleration People's Perception

Indoor Conditions Outdoor Conditions

| Intensity Classification | | Personal Sensation | Indoor Situation | Outdoor Situation |
|---|---|---|---|---|
| 0 | No sensation | People do not feel anything | | |
| 1 | Microseismic | People can feel slight shaking when stationary | | |
| 2 | Light Earthquake | Most people can feel shaking, and some sleeping individuals may wake up | Hanging objects like lamps may sway slightly. | Parked cars might rock gently, similar to the sensation of a passing truck, but it is brief. |
| 3 | Minor Earthquake | Almost everyone feels shaking, and some may experience fear. | Houses shake, dishes rattle, and doors and windows may make noise. | Parked cars noticeably rock, and power lines may sway slightly. |
| 4 | Light Earthquake | There is a considerable level of fear, and some people may seek refuge. People who are sleeping are almost always awakened. | Houses shake severely, unstable objects may topple, and heavier furniture can move. There may be minor disasters. | Motorists may feel a slight sensation, power lines sway noticeably, and pedestrians feel the shaking. |

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| Intensity Classification | | Personal Sensation | Indoor Situation | Outdoor Situation |
|---|---|---|---|---|
| 5 weak | Strong Earthquake | Most people will feel scared and panicked. | Partial collapse of unsecured objects, with some furniture possibly moving or toppling over. Some doors and windows may warp, and cracks may appear in some walls. | Some buildings experience peeling of wall tiles, and in some mountainous areas, falling rocks may occur. Soft soil layers may exhibit sand and mud spraying. Power, water, gas, or communication interruptions may happen in some areas. |
| 5 strong | | Violent shaking to the point where almost everyone feels scared and panicked, making it difficult to move. | Extensive collapse of unsecured objects, with furniture moving or toppling over. Some doors and windows deform, and cracks appear in walls. A very small number of less earthquake-resistant structures may be damaged or collapse. | Some buildings experience peeling of wall tiles, and in some mountainous areas, falling rocks may occur. Soft soil layers may exhibit sand and mud spraying. Power, water, gas, or communication interruptions may happen in some areas. A few less earthquake-resistant brick walls may be damaged or collapse. |

| Intensity Classification | | Personal Sensation | Indoor Situation | Outdoor Situation |
|---|---|---|---|---|
| 6 weak | Severe Earthquake | Intense shaking makes it difficult to stand. | Many pieces of furniture significantly move or topple over, doors and windows twist and deform, and some poorly seismic-resistant houses may be damaged or collapse. | Cracks may appear on the ground, and in some mountainous areas, landslides may occur. Loose soil layers may exhibit sand and mud eruptions. There might be interruptions in electricity, water supply, gas, or communication in some areas. |
| 6 strong | | Intense shaking makes it impossible to stand steadily. | A large amount of furniture may move or topple over significantly, doors and windows may twist and deform, and some houses with poor seismic resistance may be damaged or collapse. Even houses with stronger seismic resistance may suffer damage. | Cracks may appear on the ground, landslides may occur in mountainous areas, and loose soil layers may exhibit sand and mud eruptions. There could be widespread interruptions in electricity, water supply, gas, or communication in affected areas. |
| 7 | Severe Earthquake | Intense shaking, making it difficult to move according to one's will. | Almost all furniture may move or topple over significantly, and even buildings with stronger seismic resistance may be damaged or collapse. | Landslides may occur, altering the terrain. Multiple areas may experience sand and mud eruptions in loose soil layers. Widespread interruptions in electricity, water supply, gas, or communication may occur, and railway tracks may bend. |

The indoor conditions in this table are based on lower-floor examples.

The main difference between the current seismic intensity classification standard and the old standard lies in the fact that the old standard only used the maximum ground acceleration value (PGA) as a reference, while the current standard considers both PGA and peak ground velocity (PGV). The comparison table is as follows.

Table of Maximum Ground Acceleration Values (PGA), Seismic Intensity 4 and below are determined based on PGA.

| **Intensity Levels** | **0** | **1** | **2** | **3** | **4** | 5 weak | 5 strong | 6 weak | 6 strong | 7 |
|---|---|---|---|---|---|---|---|---|---|---|
| **PGA (cm/sec²)** | **<0.8** | **0.8 ~ 2.5** | **2.5~ 8.0** | **8.0 ~ 25** | **25 ~ 80** | 80~ 140 | 140 ~ 250 | 250 ~ 440 | 440 ~ 800 | >800 |

Ground Motion Velocity Levels for Seismic Intensity Levels 5 and above are determined based on PGV.

| **Intensity Levels** | 0 | 1 | 2 | 3 | 4 | **5 weak** | **5 strong** | **6 weak** | **6 strong** | **7** |
|---|---|---|---|---|---|---|---|---|---|---|
| **PGA (cm/sec²)** | <0.8 | 0.8 ~ 2.5 | 2.5~ 8.0 | 8.0 ~ 25 | 25 ~ 80 | **80~ 140** | **140 ~ 250** | **250 ~ 440** | **440 ~ 800** | **>800** |

Note: This seismic intensity classification standard is supported starting from firmware version 2105.

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