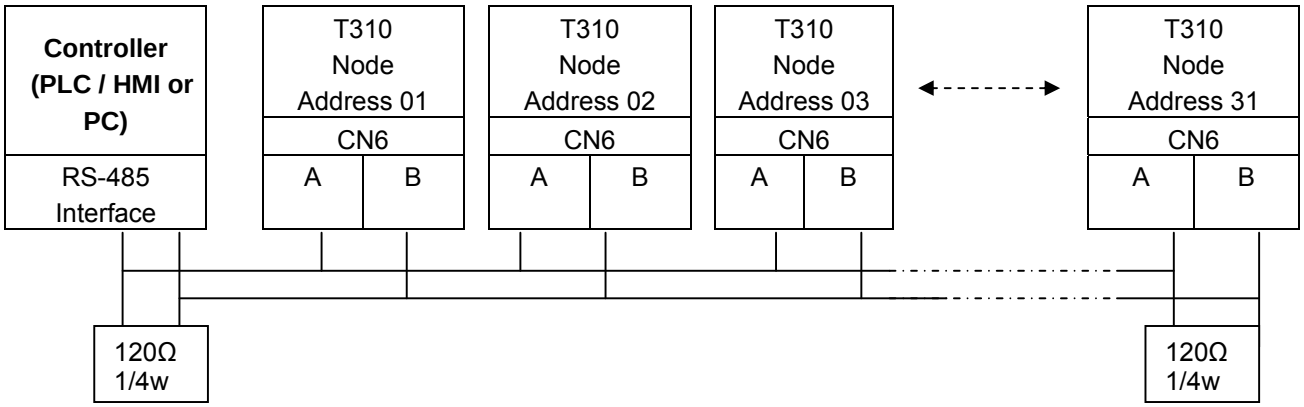
# 4.4 Modbus Protocol Descriptions

## 4.4.1 Communication Connection and Data Frame

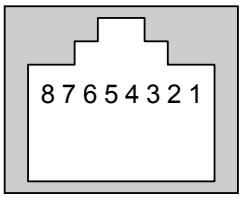
The inverter can communicate with a PC or PLC via RS485 using the Modbus RTU or Modbus ACSII protocol. A maximum of 84 BYTES can be received, and 80 BYTES can be sent.

**Network Connection**




**** Terminate the communications line with a (120 ohm, 1/4 watt) resistor at both ends.**

**CN6 Pin out**




| PIN | Signal | PIN | Signal |
|---|---|---|---|
| 1 | RS-485 A signal | 5 | Reserved |
| 2 | RS-485 B signal | 6 | RS-485 B signal |
| 3 | RS-485 A signal | 7 | VCC of isolated 5V power supply |
| 4 | Reserved | 8 | GND of isolated 5V power supply |

For RS-485 communication use pin 1 or pin 3 for A and pin 2 or pin 6 for B

### Data Format Frame

### Data Frame for ASCII Mode

| | |
|---|---|
| STX(3AH) | Start Bit = 3AH |
| Node Address Hi | Communication Address(Station):<br>2-digit ASCII Code |
| Node Address Lo | |
| Function Hi | Function Code (command):<br>2-digit ASCII Code |
| Function Lo | |
| Command Start Address | Command Start byte:<br>4-digit ASCII Code |
| Command Start Address | |
| Command Start Address | |
| Command Start Address | |
| Data length | The length of the command:<br>4-digit ASCII Code |
| Data length | |
| Data length | |
| Data length | |
| LRC Check Hi | LRC Check Code:<br>2-digit ASCII Code |
| LRC Check Lo | |
| END Hi | End Byte:<br>END Hi=CR(0DH), END Li = LF(0AH) |
| END Lo | |

#### Data Frame for RTU Mode

Master (PLC etc.) sends request to follower (inverter), and the follower sends a response to the master (PC, PLC). The data received is illustrated here.

The data length varies depending on the command (Function).

| |
|---|
| Node Address |
| Function Code |
| DATA |
| CRC CHECK |
| Signal Interval |

** The inverter response time is 10ms.

#### Node Address

00H: Broadcast to all the drivers
01H: to the No. 01 inverter
0FH: to the No.15 inverter
10H: to the No.16 inverter and so on...., max to No.31 (1FH)

#### Function Code

03H: Read the register contents

06H: Write a WORD to register
08H: Loop test
10H: Write several data to register (complex number register write)

**Checksum Calculation**

**LRC**

| | | |
|---|---|---|
| ex. | NODE ADDRESS | 01H |
| | FUNCTION | 03H |
| | COMMAND | 01H |
| | | 00H |
| + | DATA LENGTH | 0AH |
| --- | --- | --- |
| | | 0FH ---------- 2's complement |
| | Checksum | F1H |
| | CS (H) | 46H (ASCII) |
| | CS (L) = | 31H (ASCII) |

**CRC**

CRC Check: CRC code covers the content from node address to DATA. Please calculate it according to the following methods.

(1) Load a 16-bit register with FFFF hex (all1's). Call this CRC register.
(2) Exclusive OR the first 8-bit byte of the message, the low-order byte of the 16-bit CRC register, putting the result in the CRC register.
(3) Shift the CRC register one bit to the right (toward the LSB), Zero-filling the MSB, Extract and examines the LSB.
(4) (If the LSB was 0): Repeat Steps (3) (another shift)
(If the LSB was 1): Exclusive OR the CRC register with the polynomial value A001 hex (1010 0000 0000 0001), putting the result in CRC register.
(5) Repeat Steps (3) and (4) until 8 shifts been performed. When this is done, a complete 8-bit byte will be processed.
(6) Repeat Steps (2) through (5) for next 8-bit byte of the message, Continue doing this until all bytes have been processed. The final content in the CRC register is the CRC value. When sending the CRC value, the Low-order byte should be sent firstly, then the High-order byte. For example, CRC value: 1241 Hex, the high-order byte should be set to 41hex and low-order byte 12hex.

**CRC calculate program (C language):**

```
UWORD ch_sum (UBYTE long, UBYTE *rxdbuff )
{
    BYTE i = 0;
    UWORD wkg = 0xFFFF;
    while ( long-- ) {
        wkg ^= rxdbuff++;
        for ( i = 0 ; i < 8; i++ ) {
            if ( wkg & 0x0001 ) {
               wkg = ( wkg >> 1 ) ^ 0xa001;
            }
            else {
               wkg = wkg >> 1;
            }
         }
     }
    return( wkg );
}
```

| ASCII Mode | |
|---|---|
| STX | ':' |
| Address | '0' |
| | '1' |
| Function | '8' |
| | '6' |
| Exception code | '5' |
| | '1' |
| LRC Check | '2' |
| | '8' |
| END | 'CR' |
| | 'LF' |

| RTU Mode | | |
|---|---|---|
| Node Address | | 02H |
| Function | | 83H |
| Exception code | | 52H |
| CRC-16 | High | C0H |
| | Low | CDH |

During a communication error the drive will response with an Exception Code and send a message back to the main system consisting of a Function Code that is "ANDED (and 80h)" with 80 Hex.

| Exception code | Content |
|---|---|
| 01 | Function code error |
| 02 | Register number error |
| 03 | DATA setting error |
| 04 | Register number is over 32 |

## 4.4.2 Register and Data Format

**Command Data (Read / Write)**

| Register No. | | Bit | Content |
|---|---|---|---|
| 2500H | Reserved | | |
| 2501H | Operation Signal | 0 | Operation Command 1 : Run 0 : Stop |
| | | 1 | Reverse Command 1 : Reverse 0 : Forward |
| | | 2 | External Fault 1 : Fault |
| | | 3 | Fault Reset 1 : Reset |
| | | 4 | Reserved |
| | | 5 | Reserved |
| | | 6 | Multi-function Comm S1 1 :“ON” |
| | | 7 | Multi-function Comm S2 1 :“ON” |
| | | 8 | Multi-function Comm S3 1 :“ON” |
| | | 9 | Multi-function Comm S4 1 :“ON” |
| | | A | Multi-function Comm S5 1 :“ON” |
| | | B | Multi-function Comm S6 1 :“ON” |
| | | C | Reserved |
| | | D | Reserved |
| | | E | Inverter mode 1 : “ON” |
| | | F | Torque Command set by Communication 1: “ON” |
| 2502H | | | *Frequency Command (Unit: 0.01Hz) |
| 2503H | | | Torque Command (+/-8192 corresponding to the rated torque +/-100%) |
| 2504H | | | Speed limit (+/- 120 corresponding +/-120%) |
| 2505H | | | AO1 (0.00V ~ 10.00V) |
| 2506H | | | AO2 (0 ~ 1000): Voltage (corresponding to 0.00~10.00V); Current ( corresponding to 4mA~20mA) |
| 2507H | | | DO |
| 2508H | | | Reserved |
| 2509H | | | Reserved |
| 250AH | | | Reserved |
| 250BH | | | Reserved |
| 250CH | | | Reserved |
| 250DH | | | Reserved |
| 250EH | | | Reserved |
| 250FH | | | Reserved |
| 2510H | | | G12-00 H-WORD |
| 2511H | | | G12-00 L-WORD |

**Note: Write in zero for Not used BIT, do not write in data for the reserved register.**

**Monitor Data (Read-only)**

| Register No. | | Bit | Content | | | |
|---|---|---|---|---|---|---|
| 2520H | State Signal | 0 | Operation | 1 : Run | 0 : Stop | |
| | | 1 | Direction | 1 : Reverse | 0 : Forward | |
| | | 2 | Inverter ready | 1 : ready | 0 : unready | |
| | | 3 | Fault | 1 : Abnormal | | |
| | | 4 | Warning | 1 :“ON” | | |
| | | 5 | Zero Speed | 1 :“ON” | | |
| | | 6 | 380V series | 1 :“ON” | | |
| | | 7 | Frequency Agree | 1 :“ON” | | |
| | | 8 | Set Frequency Agree | 1 :“ON” | | |
| | | 9 | Frequency Detection 1 | 1 :“ON” | | |
| | | A | Frequency Detection 2 | 1 :“ON” | | |
| | | B | Under Voltage | 1 :“ON” | | |
| | | C | Baseblock | 1 :“ON” | | |
| | | D | Freq Ref. not from Comm. | 1 :“ON” | | |
| | | E | Seq. not from Comm. | 1 :“ON” | | |
| | | F | Over Torque | 1 :“ON” | | |
| 2521H | Error Description | 0 | | 30 | | |
| | | 1 | UV | 31 | | |
| | | 2 | OC | 32 | | |
| | | 3 | OV | 33 | | |
| | | 4 | OH1 | 34 | | |
| | | 5 | OL1 | 35 | | |
| | | 6 | OL2 | 36 | | |
| | | 7 | OT | 37 | | |
| | | 8 | UT | 38 | CF07 | |
| | | 9 | SC | 39 | | |
| | | 10 | Ground OC | 40 | | |
| | | 11 | Reserved | 41 | Reserved | |
| | | 12 | Input Phase Loss | 42 | | |
| | | 13 | Output Phase Loss | 43 | | |
| | | 14 | Reserved | 44 | | |
| | | 15 | Reserved | 45 | | |
| | | 16 | Reserved | 46 | | |
| | | 17 | External Fault 01 | 47 | SS1 | |
| | | 18 | External Fault 02 | 48 | Reserved | |
| | | 19 | External Fault 03 | 49 | RUN | |
| | | 20 | External Fault 04 | 50 | OCA | |
| | | 21 | External Fault 05 | 51 | OCD | |
| | | 22 | External Fault 06 | 52 | OCC | |
| | | 23 | Reserved | 53 | Reserved | |
| | | 24 | Reserved | 54 | | |
| | | 25 | FB | 55 | | |
| | | 26 | Reserved | 56 | | |
| | | 27 | | 57 | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 28 | CE | | | 58 | | | |
| | | | 29 | STO | | | 59 | | | |
| | | | 30 | Reserved | | | 61 | | | |
| 2522H | | DI State | 0 | Terminal S1 | | | | | | |
| | | | 1 | Terminal S2 | | | | | | |
| | | | 2 | Terminal S3 | | | | | | |
| | | | 3 | Terminal S4 | | | | | | |
| | | | 4 | Terminal S5 | | | | | | |
| | | | 5 | Terminal S6 | | | | | | |
| | | | 6 | Reserved | | | | | | |
| | | | 7 | Reserved | | | | | | |
| | | | 8 | Reserved | | | | | | |
| | | | 9 | Reserved | | | | | | |
| | | | A | Reserved | | | | | | |
| | | | B | Reserved | | | | | | |
| | | | C | Reserved | | | | | | |
| | | | D | Reserved | | | | | | |
| | | | E | Reserved | | | | | | |
| | | | F | Reserved | | | | | | |
| 2523H | | | Frequency command (0.01Hz) | | | | | | | |
| 2524H | | | Output frequency (0.01Hz) | | | | | | | |
| 2525H | | | Reserved | | | | | | | |
| 2526H | | | DC voltage command (0.1V) | | | | | | | |
| 2527H | | | Output current (0.1A) | | | | | | | |
| 2528H | | Warning Description | 0 | No alarm | 20 | EF4 | 40 | EF | 60 | Reserved |
| | | | 1 | OV | 21 | EF5 | 41 | Reserved | 61 | RETRY |
| | | | 2 | UV | 22 | EF6 | 42 | Reserved | 62 | Reserved |
| | | | 3 | OL2 | 23 | Reserved | 43 | Reserved | 63 | Reserved |
| | | | 4 | OH2 | 24 | Reserved | 44 | Reserved | 64 | Reserved |
| | | | 5 | Reserved | 25 | Reserved | 45 | OL1 | 65 | OH1 |
| | | | 6 | OT | 26 | CLB | 46 | HP_ER | 66 | FIRE |
| | | | 7 | Reserved | 27 | Reserved | 47 | SE10 | 67 | ES |
| | | | 8 | Reserved | 28 | CT | 48 | Reserved | 68 | STP1 |
| | | | 9 | UT | 29 | USP | 49 | BB1 | 69 | BDERR |
| | | | 10 | Reserved | 30 | Reserved | 50 | BB2 | 70 | EPERR |
| | | | 11 | Reserved | 31 | Reserved | 51 | BB3 | 71 | ADCER |
| | | | 12 | Reserved | 32 | FB | 52 | BB4 | 72 | Reserved |
| | | | 13 | CE | 33 | Reserved | 53 | BB5 | 73 | STP0 |
| | | | 14 | CALL | 34 | SE01 | 54 | BB6 | 74 | Reserved |
| | | | 15 | Reserved | 35 | SE02 | 55 | Reserved | 75 | STP2 |
| | | | 16 | EF0 | 36 | SE03 | 56 | Reserved | 76 | RUNER |
| | | | 17 | EF1 | 37 | Reserved | 57 | Reserved | | |
| | | | 18 | EF2 | 38 | SE05 | 58 | Reserved | | |
| | | | 19 | EF3 | 39 | HPERR | 59 | Reserved | | |
| 2529H | | | Digital Output State | | | | | | | |
| 252AH | | | AO1 (0.00V ~ 10.00V) | | | | | | | |

| | | | |
|---|---|---|---|
| 252BH | | | AO2 (0 ~ 1000): Voltage (corresponding to 0.00~10.00V); Current (corresponding to 4mA~20mA) |
| 252CH | | | Analog Input 1 (0.1%) |
| 252DH | | | Analog Input 2 (0.1%) |
| 252EH | | | Reserved |
| 252FH | | | L510(s)/ E510/ A510(s)/ F510/T310 Check（0x600） |

**Note: Write in zero for Not used BIT, do not write in data for the reserved register.**

**Read Holding Register [03H]**

Read consecutive holding registers. The address of the first holding register is specified in the protocol
Example: Read frequency command from the inverter with node address 1.

**ASCII Mode**

**Command Message**

| | |
|---|---|
| 3AH | STX |
| 30H | Node Address |
| 31H | |
| 30H | Function |
| 33H | |
| 30H | Starting Register |
| 31H | |
| 32H | |
| 33H | |
| 30H | Number of Registers |
| 30H | |
| 30H | |
| 31H | |
| ? | LRC CHECK |
| ? | |
| 0DH | END |
| 0AH | |

**Response Message (Normal)**

| | |
|---|---|
| 3AH | STX |
| 30H | Node Address |
| 31H | |
| 30H | Function |
| 33H | |
| 30H | Data Length |
| 32H | |
| 31H | Initial Save Register |
| 37H | |
| 37H | |
| 30H | |
| ? | LRC CHECK |
| ? | |
| 0DH | END |
| 0AH | |

**Response Message (Error)**

| | |
|---|---|
| 3AH | STX |
| 30H | Node Address |
| 31H | |
| 38H | Function |
| 33H | |
| 30H | Exception code |
| 34H | |
| 34H | LRC CHECK |
| 30H | |
| 0DH | END |
| 0AH | |

**RTU Mode**

**Command Message**

| | | |
|---|---|---|
| Node Address | | 01 H |
| Function | | 03H |
| Starting Register | High | 0CH |
| | Low | 10H |
| Number of Registers | High | 00H |
| | Low | 01H |
| CRC-16 | High | 86H |
| | Low | 9FH |

**Response Message (Normal)**

| | | |
|---|---|---|
| Node Address | | 01H |
| Function | | 03H |
| Data Length | | 02H |
| Initial Save Register | High | 17H |
| | Low | 70H |
| CRC-16 | High | B6H |
| | Low | 50H |

**Response Message (Error)**

| | | |
|---|---|---|
| Node Address | | 01H |
| Function | | 83H |
| Exception code | | 04H |
| CRC-16 | High | 40H |
| | Low | F3H |

**Loop back test [08H]**

Check the communication between the master and the follower (inverter). The data used can be arbitrary.

**ASCII Mode**

**Command Message**

| | |
|---|---|
| 3AH | STX |
| 30H | Node Address |
| 31H | |
| 30H | Function |
| 38H | |
| 30H | Test Code |
| 30H | |
| 30H | |
| 30H | |
| 41H | DATA |
| 35H | |
| 33H | |
| 37H | |
| 31H | LRC CHECK |
| 42H | |
| 0DH | END |
| 0AH | |

**Response Message (Normal)**

| | |
|---|---|
| 3AH | STX |
| 30H | Node Address |
| 31H | |
| 30H | Function |
| 38H | |
| 30H | Test Code |
| 30H | |
| 30H | |
| 30H | |
| 41H | DATA |
| 35H | |
| 33H | |
| 37H | |
| 31H | LRC CHECK |
| 42H | |
| 0DH | END |
| 0AH | |

**Response Message (Error)**

| | |
|---|---|
| 3AH | STX |
| 30H | Node Address |
| 31H | |
| 38H | Function |
| 38H | |
| 30H | Exception code |
| 33H | |
| 30H | LRC CHECK |
| 36H | |
| 0DH | END |
| 0AH | |

**RTU Mode**

**Command Message**

| | | |
|---|---|---|
| Node Address | | 01 H |
| Function | | 08H |
| Test Code | High | 00H |
| | Low | 00H |
| DATA | High | A5H |
| | Low | 37H |
| CRC-16 | High | DAH |
| | Low | 8DH |

**Response Message (Normal)**

| | | |
|---|---|---|
| Node Address | | 01H |
| Function | | 08H |
| Test Code | High | 00H |
| | Low | 00H |
| DATA | High | A5H |
| | Low | 37H |
| CRC-16 | High | DAH |
| | Low | 8DH |

**Response Message (Error)**

| | | |
|---|---|---|
| Node Address | | 01H |
| Function | | 88H |
| Exception code | | 03H |
| CRC-16 | High | 06H |
| | Low | 01H |

**Write Single Holding Register [06H]**

Write single holding register. The register address of the holding register is specified in the message.

**Example:** Write a 60.00Hz frequency command to node address 1.

**ASCII Mode**

**Command Message**

| | |
|---|---|
| 3AH | STX |
| 30H | Node Address |
| 31H | |
| 30H | Function |
| 36H | |
| 32H | Starting Register |
| 35H | |
| 30H | |
| 32H | |
| 31H | DATA |
| 37H | |
| 37H | |
| 30H | |
| 34H | LRC CHECK |
| 42H | |
| 0DH | END |
| 0AH | |

**Response Message (Normal)**

| | |
|---|---|
| 3AH | STX |
| 30H | Node Address |
| 31H | |
| 30H | Function |
| 36H | |
| 32H | Starting Register |
| 35H | |
| 30H | |
| 32H | |
| 31H | DATA |
| 37H | |
| 37H | |
| 30H | |
| 34H | LRC CHECK |
| 42H | |
| 0DH | END |
| 0AH | |

**Response Message (Error)**

| | |
|---|---|
| 3AH | STX |
| 30H | Node Address |
| 31H | |
| 38H | Function |
| 36H | |
| 30H | Exception code |
| 33H | |
| 30H | LRC CHECK |
| 32H | |
| 0DH | END |
| 0AH | |

**RTU Mode**

**Command Message**

| | | |
|---|---|---|
| Node Address | | 01 H |
| Function | | 06H |
| Start No | High | 25H |
| | Low | 02H |
| DATA | High | 17H |
| | Low | 70H |
| CRC-16 | High | 2DH |
| | Low | 12H |

**Response Message (Normal)**

| | | |
|---|---|---|
| Node Address | | 01H |
| Function | | 06H |
| Start No | High | 25H |
| | Low | 02H |
| DATA | High | 17H |
| | Low | 70H |
| CRC-16 | High | 2DH |
| | Low | 12H |

**Response Message (Error)**

| | | |
|---|---|---|
| Node Address | | 01H |
| Function | | 86H |
| Exception code | | 03H |
| CRC-16 | High | 02H |
| | Low | 61H |

**Write Multiple Holding Register [10H]**

Write multiple holding registers. The address of the first holding register is specified in the message.

**Example:** Write a 60.00Hz frequency command to node address 1 and enable FWD run command.

**ASCII Mode**

**Command Message**

| | |
|---|---|
| 3AH | STX |
| 30H | Node Address |
| 31H | |
| 31H | Function |
| 30H | |
| 30H | Starting Register |
| 31H | |
| 30H | |
| 31H | |
| 30H | Number of Registers |
| 30H | |
| 30H | |
| 32H | |
| 30H | Number of Bytes* |
| 34H | |
| 30H | DATA 1 |
| 30H | |
| 30H | |
| 31H | |
| 31H | DATA 2 |
| 37H | |
| 37H | |
| 30H | |
| 33H | LRC CHECK |
| 42H | |
| 0DH | END |
| 0AH | |

**Response Message (Normal)**

| | |
|---|---|
| 3AH | STX |
| 30H | Node Address |
| 31H | |
| 31H | Function |
| 30H | |
| 32H | Starting Register |
| 35H | |
| 30H | |
| 31H | |
| 30H | Number of Registers |
| 30H | |
| 30H | |
| 32H | |
| 43H | LRC CHECK |
| 37H | |
| 0DH | END |
| 0AH | |

**Response Message (Error)**

| | |
|---|---|
| 3AH | STX |
| 30H | Node Address |
| 31H | |
| 39H | Function |
| 30H | |
| 30H | Exception code |
| 33H | |
| 30H | LRC CHECK |
| 43H | |
| 0DH | END |
| 0AH | |

* Number of bytes is register amount x 2

**RTU Mode**

Command Message

| | | |
|---|---|---|
| Node Address | | 01H |
| Function | | 10H |
| Starting Register | High | 25H |
| | Low | 01H |
| Number of Registers | High | 00H |
| | Low | 02H |
| Number of Bytes* | | 04H |
| DATA 1 | High | 00H |
| | Low | 01H |
| DATA 2 | High | 17H |
| | Low | 70H |
| CRC-16 | High | 60H |
| | Low | 27H |

Response Message (Normal)

| | | |
|---|---|---|
| Node Address | | 01H |
| Function | | 10H |
| Starting Register | High | 25H |
| | Low | 01H |
| Number of Registers | High | 00H |
| | Low | 02H |
| CRC-16 | High | 1BH |
| | Low | 04H |

Response Message (Error)

| | | |
|---|---|---|
| Node Address | | 01H |
| Function | | 90H |
| Exception code | | 03H |
| CRC-16 | High | 0CH |
| | Low | 01H |

* Data amount is register amount x 2

## 4.4.3 Parameter Data

| Function | Register No | Function | Register No | | |
|---|---|---|---|---|---|
| Group 0 | | Group 1 | | | |
| 0 – 00 | 0000H | 1 – 00 | 0100H | | |
| 0 – 01 | 0001H | 1 – 01 | 0101H | | |
| 0 – 02 | 0002H | 1 – 02 | 0102H | | |
| 0 – 03 | 0003H | 1 – 03 | 0103H | | |
| 0 – 04 | 0004H | 1 – 04 | 0104H | | |
| 0 – 05 | 0005H | 1 – 05 | 0105H | | |
| 0 – 06 | 0006H | 1 – 06 | 0106H | | |
| 0 – 07 | 0007H | 1 – 07 | 0107H | | |
| 0 – 08 | 0008H | 1 – 08 | 0108H | | |
| 0 – 09 | 0009H | 1 – 09 | 0109H | | |
| 0 – 10 | 000AH | 1 – 10 | 010AH | | |
| 0 – 11 | 000BH | 1 – 11 | 010BH | | |
| 0 – 12 | 000CH | 1 – 12 | 010CH | | |
| 0 – 13 | 000DH | 1 – 13 | 010DH | | |
| 0 – 14 | 000EH | 1 – 14 | 010EH | | |
| 0 – 15 | 000FH | 1 – 15 | 010FH | | |
| 0 – 16 | 0010H | 1 – 16 | 0110H | | |
| 0 – 17 | 0011H | 1 – 17 | 0111H | | |
| 0 – 18 | 0012H | 1 – 18 | 0112H | | |
| 0 – 19 | 0013H | 1 – 19 | 0113H | | |
| 0 – 20 | 0014H | 1 – 20 | 0114H | | |
| 0 – 21 | 0015H | 1 – 21 | 0115H | | |
| 0 – 22 | 0016H | 1 – 22 | 0116H | | |
| 0 – 23 | 0017H | 1 – 23 | 0117H | | |
| 0 – 24 | 0018H | 1 – 24 | 0118H | | |
| 0 – 25 | 0019H | 1 – 25 | 0119H | | |
| 0 – 26 | 001AH | 1 – 26 | 011AH | | |
| 0 – 27 | 001BH | | | | |
| 0 – 28 | 001CH | | | | |
| 0 – 29 | 001DH | | | | |
| 0 – 30 | 001EH | | | | |
| 0 – 31 | 001FH | | | | |
| 0 – 32 | 0020H | | | | |
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| Function | Register No | Function | Register No | Function | Register No |
|---|---|---|---|---|---|
| Group 2 | | Group 3 | | Group 3 | |
| 2 – 00 | 0200H | 3 – 00 | 0300H | 3 – 44 | 032CH |
| 2 – 01 | 0201H | 3 – 01 | 0301H | 3 – 45 | 032DH |
| 2 – 02 | 0202H | 3 – 02 | 0302H | 3 – 46 | 032EH |
| 2 – 03 | 0203H | 3 – 03 | 0303H | 3 – 47 | 032FH |
| 2 – 04 | 0204H | 3 – 04 | 0304H | 3 – 48 | 0330H |
| 2 – 05 | 0205H | 3 – 05 | 0305H | 3 – 49 | 0331H |
| 2 – 06 | 0206H | 3 – 06 | Reserved | | |
| 2 – 07 | 0207H | 3 – 07 | Reserved | | |
| 2 – 08 | 0208H | 3 – 08 | 0308H | | |
| 2 – 09 | 0209H | 3 – 09 | 0309H | | |
| 2 – 10 | 020AH | 3 – 10 | 030AH | | |
| 2 – 11 | 020BH | 3 – 11 | 030BH | | |
| 2 – 12 | 020CH | 3 – 12 | 030CH | | |
| 2 – 13 | 020DH | 3 – 13 | 030DH | | |
| 2 – 14 | 020EH | 3 – 14 | 030EH | | |
| 2 – 15 | 020FH | 3 – 15 | 030FH | | |
| 2 – 16 | 0210H | 3 – 16 | 0310H | | |
| 2 – 17 | 0211H | 3 – 17 | 0311H | | |
| 2 – 18 | 0212H | 3 – 18 | 0312H | | |
| 2 – 19 | 0213H | 3 – 19 | 0313H | | |
| 2 – 20 | 0214H | 3 – 20 | 0314H | | |
| 2 – 21 | 0215H | 3 – 21 | 0315H | | |
| 2 – 22 | 0216H | 3 – 22 | 0316H | | |
| 2 – 23 | 0217H | 3 – 23 | 0317H | | |
| 2 – 24 | 0218H | 3 – 24 | 0318H | | |
| 2 – 25 | 0219H | 3 – 25 | 0319H | | |
| 2 – 26 | 021AH | 3 – 26 | 031AH | | |
| 2 – 27 | 021BH | 3 – 27 | 031BH | | |
| 2 – 28 | 021CH | 3 – 28 | 031CH | | |
| 2 – 29 | 021DH | 3 – 29 | 031DH | | |
| 2 – 30 | 021EH | 3 – 30 | 031EH | | |
| 2 – 31 | 021FH | 3 – 31 | 031FH | | |
| 2 – 32 | 0220H | 3 – 32 | 0320H | | |
| 2 – 33 | 0221H | 3 – 33 | 0321H | | |
| 2 – 34 | 0222H | 3 – 34 | 0322H | | |
| 2 – 35 | 0223H | 3 – 35 | 0323H | | |
| 2 – 36 | 0224H | 3 – 36 | 0324H | | |
| 2 – 37 | 0225H | 3 – 37 | 0325H | | |
| | | 3 – 38 | 0326H | | |
| | | 3 – 39 | 0327H | | |
| | | 3 – 40 | 0328H | | |
| | | 3 – 41 | 0329H | | |
| | | 3 – 42 | 032AH | | |
| | | 3 – 43 | 032BH | | |

| Function | Register No | Function | Register No | Function | Register No |
|---|---|---|---|---|---|
| Group 4 | | Group 5 | | Group 5 | |
| 4 – 00 | 0400H | 5 – 00 | 0500H | 5 – 33 | 0521H |
| 4 – 01 | 0401H | 5 – 01 | 0501H | 5 – 34 | 0522H |
| 4 – 02 | 0402H | 5 – 02 | 0502H | 5 – 35 | 0523H |
| 4 – 03 | 0403H | 5 – 03 | 0503H | 5 – 36 | 0524H |
| 4 – 04 | 0404H | 5 – 04 | 0504H | 5 – 37 | 0525H |
| 4 – 05 | 0405H | 5 – 05 | 0505H | 5 – 38 | 0526H |
| 4 – 06 | 0406H | 5 – 06 | 0506H | 5 – 39 | 0527H |
| 4 – 07 | 0407H | 5 – 07 | 0507H | 5 – 40 | 0528H |
| 4 – 08 | 0408H | 5 – 08 | 0508H | 5 – 41 | 0529H |
| 4 – 09 | 0409H | 5 – 09 | 0509H | 5 – 42 | 052AH |
| 4 – 10 | 040AH | 5 – 10 | 050AH | 5 – 43 | 052BH |
| 4 – 11 | 040BH | 5 – 11 | 050BH | 5 – 44 | 052CH |
| 4 – 12 | 040CH | 5 – 12 | 050CH | 5 – 45 | 052DH |
| 4 – 13 | 040DH | 5 – 13 | 050DH | 5 – 46 | 052EH |
| 4 – 14 | 040EH | 5 – 14 | 050EH | 5 – 47 | 052FH |
| 4 – 15 | 040FH | 5 – 15 | 050FH | 5 – 48 | 0530H |
| 4 – 16 | 0410H | 5 – 16 | 0510H | | |
| 4 – 17 | 0411H | 5 – 17 | 0511H | | |
| 4 – 18 | 0412H | 5 – 18 | 0512H | | |
| 4 – 19 | 0413H | 5 – 19 | 0513H | | |
| 4 – 20 | 0414H | 5 – 20 | 0514H | | |
| | | 5 – 21 | 0515H | | |
| | | 5 – 22 | 0516H | | |
| | | 5 – 23 | 0517H | | |
| | | 5 – 24 | 0518H | | |
| | | 5 – 25 | 0519H | | |
| | | 5 – 26 | 051AH | | |
| | | 5 – 27 | 051BH | | |
| | | 5 – 28 | 051CH | | |
| | | 5 – 29 | 051DH | | |
| | | 5 – 30 | 051EH | | |
| | | 5 – 31 | 051FH | | |
| | | 5 – 32 | 0520H | | |

| Function | Register No | Function | Register No | Function | Register No |
|---|---|---|---|---|---|
| Group 6 | | Group 6 | | Group 7 | |
| 6 – 00 | 0600H | 6 – 41 | 0629H | 7 – 00 | 0700H |
| 6 – 01 | 0601H | 6 – 42 | 062AH | 7 – 01 | 0701H |
| 6 – 02 | 0602H | 6 – 43 | 062BH | 7 – 02 | 0702H |
| 6 – 03 | 0603H | 6 – 44 | 062CH | 7 – 03 | 0703H |
| 6 – 04 | 0604H | 6 – 45 | 062DH | 7 – 04 | 0704H |
| 6 – 05 | 0605H | 6 – 46 | 062EH | 7 – 05 | 0705H |
| 6 – 06 | 0606H | 6 – 47 | 062FH | 7 – 06 | 0706H |
| 6 – 07 | 0607H | | | 7 – 07 | 0707H |
| 6 – 08 | 0608H | | | 7 – 08 | 0708H |
| 6 – 09 | 0609H | | | 7 – 09 | 0709H |
| 6 – 10 | 060AH | | | 7 – 10 | 070AH |
| 6 – 11 | 060BH | | | 7 – 11 | 070BH |
| 6 – 12 | 060CH | | | 7 – 12 | 070CH |
| 6 – 13 | 060DH | | | 7 – 13 | 070DH |
| 6 – 14 | 060EH | | | 7 – 14 | 070EH |
| 6 – 15 | 060FH | | | 7 – 15 | 070FH |
| 6 – 16 | 0610H | | | 7 – 16 | 0710H |
| 6 – 17 | 0611H | | | 7 – 17 | 0711H |
| 6 – 18 | 0612H | | | 7 – 18 | 0712H |
| 6 – 19 | 0613H | | | 7 – 19 | 0713H |
| 6 – 20 | 0614H | | | 7 – 20 | 0714H |
| 6 – 21 | 0615H | | | 7 – 21 | 0715H |
| 6 – 22 | 0616H | | | 7 – 22 | 0716H |
| 6 – 23 | 0617H | | | 7 – 23 | 0717H |
| 6 – 24 | 0618H | | | 7 – 24 | 0718H |
| 6 – 25 | 0619H | | | 7 – 25 | 0719H |
| 6 – 26 | 061AH | | | 7 – 26 | 071AH |
| 6 – 27 | 061BH | | | 7 – 27 | 071BH |
| 6 – 28 | 061CH | | | 7 – 28 | 071CH |
| 6 – 29 | 061DH | | | 7 – 29 | 071DH |
| 6 – 30 | 061EH | | | 7 – 30 | 071EH |
| 6 – 31 | 061FH | | | 7 – 31 | 071FH |
| 6 – 32 | 0620H | | | 7 – 32 | 0720H |
| 6 – 33 | 0621H | | | 7 – 33 | 0721H |
| 6 – 34 | 0622H | | | 7 – 34 | 0722H |
| 6 – 35 | 0623H | | | 7 – 35 | 0723H |
| 6 – 36 | 0624H | | | 7 – 36 | 0724H |
| 6 – 37 | 0625H | | | 7 – 42 | 072AH |
| 6 – 38 | 0626H | | | | |
| 6 – 39 | 0627H | | | | |
| 6 – 40 | 0628H | | | | |

| Function | Register No | Function | Register No | Function | Register No |
|---|---|---|---|---|---|
| Group 8 | | Group 9 | | Group 10 | |
| 8 – 00 | 0800H | 9 – 00 | 0900H | 10 – 00 | 0A00H |
| 8 – 01 | 0801H | 9 – 01 | 0901H | 10 – 01 | 0A01H |
| 8 – 02 | 0802H | 9 – 02 | 0902H | 10 – 02 | 0A02H |
| 8 – 03 | 0803H | 9 – 03 | 0903H | 10 – 03 | 0A03H |
| 8 – 04 | 0804H | 9 – 04 | 0904H | 10 – 04 | 0A04H |
| 8 – 05 | 0805H | 9 – 05 | 0905H | 10 – 05 | 0A05H |
| 8 – 06 | 0806H | 9 – 06 | 0906H | 10 – 06 | 0A06H |
| 8 – 07 | 0807H | 9 – 07 | 0907H | 10 – 07 | 0A07H |
| 8 – 08 | 0808H | 9 – 08 | 0908H | 10 – 08 | 0A08H |
| 8 – 09 | 0809H | 9 – 09 | 0909H | 10 – 09 | 0A09H |
| 8 – 10 | 080AH | | | 10 – 10 | 0A0AH |
| 8 – 11 | 080BH | | | 10 – 11 | 0A0BH |
| 8 – 12 | 080CH | | | 10 – 12 | 0A0CH |
| 8 – 13 | 080DH | | | 10 – 13 | 0A0DH |
| 8 – 14 | 080EH | | | 10 – 14 | 0A0EH |
| 8 – 15 | 080FH | | | 10 – 15 | 0A0FH |
| 8 – 16 | 0810H | | | 10 – 16 | 0A10H |
| 8 – 17 | 0811H | | | 10 – 17 | 0A11H |
| 8 – 18 | 0812H | | | 10 – 18 | 0A12H |
| 8 – 19 | 0813H | | | 10 – 19 | 0A13H |
| 8 – 20 | 0814H | | | 10 – 20 | 0A14H |
| 8 – 21 | 0815H | | | 10 – 21 | 0A15H |
| 8 – 22 | 0816H | | | 10 – 22 | 0A16H |
| 8 – 23 | 0817H | | | 10 – 23 | 0A17H |
| 8 – 24 | 0818H | | | 10 – 24 | 0A18H |
| 8 – 25 | 0819H | | | 10 – 25 | 0A19H |
| 8 – 26 | 081AH | | | 10 – 26 | 0A1AH |
| 8 – 27 | 081BH | | | 10 – 27 | 0A1BH |
| 8 – 28 | 081CH | | | 10 – 28 | 0A1CH |
| 8 – 29 | 081DH | | | 10 – 29 | 0A1DH |
| 8 – 30 | 081EH | | | 10 – 30 | 0A1EH |
| 8 – 31 | 081FH | | | 10 – 31 | 0A1FH |
| 8 – 32 | 0820H | | | 10 – 32 | 0A20H |
| 8 – 33 | 0821H | | | 10 – 33 | 0A21H |
| 8 – 34 | 0822H | | | 10 – 34 | 0A22H |
| 8 – 35 | 0823H | | | 10 – 35 | 0A23H |
| 8 – 36 | 0824H | | | 10 – 36 | 0A24H |
| 8 – 37 | 0825H | | | 10 – 37 | 0A25H |
| 8 – 38 | 0826H | | | 10 – 38 | 0A26H |
| 8 – 39 | 0827H | | | 10 – 39 | 0A27H |
| 8 – 40 | 0828H | | | 10 – 40 | 0A28H |
| 8 – 41 | 0829H | | | 10 – 41 | 0A29H |
| 8 – 42 | 082AH | | | | |
| 8 – 43 | 082BH | | | | |
| 8 – 44 | 082CH | | | | |

| Function | Register No | Function | Register No | Function | Register No |
|---|---|---|---|---|---|
| Group 11 | | Group 11 | | Group 12 | |
| 11 – 00 | 0B00H | 11 – 44 | 0B2CH | 12 – 00 | High WORD: 2510H<br>Low WORD: 2511H |
| 11 – 01 | 0B01H | 11 – 45 | 0B2DH | 12 – 01 | 0C01H |
| 11 – 02 | 0B02H | 11 – 46 | 0B2EH | 12 – 02 | 0C02H |
| 11 – 03 | 0B03H | 11 – 47 | 0B2FH | 12 – 03 | 0C03H |
| 11 – 04 | 0B04H | 11 – 48 | 0B30H | 12 – 04 | 0C04H |
| 11 – 05 | 0B05H | 11 – 49 | 0B31H | 12 – 05 | 0C05H |
| 11 – 06 | 0B06H | 11 - 50 | 0B32H | 12 – 06 | 0C06H |
| 11 – 07 | 0B07H | 11 - 51 | 0B33H | 12 – 07 | 0C07H |
| 11 – 08 | 0B08H | 11 – 52 | 0B34H | 12 – 08 | 0C08H |
| 11 – 09 | 0B09H | 11 – 53 | 0B35H | 12 – 09 | 0C09H |
| 11 – 10 | 0B0AH | 11 – 54 | 0B36H | 12 – 10 | 0C0AH |
| 11 – 11 | 0B0BH | 11 – 55 | 0B37H | 12 – 11 | 0C0BH |
| 11 – 12 | 0B0CH | 11 – 56 | 0B38H | 12 – 12 | 0C0CH |
| 11 – 13 | 0B0DH | 11 – 57 | 0B39H | 12 – 13 | 0C0DH |
| 11 – 14 | 0B0EH | 11 – 58 | 0B3AH | 12 – 14 | 0C0EH |
| 11 – 15 | 0B0FH | 11 – 59 | 0B3BH | 12 – 15 | 0C0FH |
| 11 – 16 | 0B10H | 11 – 60 | 0B3CH | 12 – 16 | 0C10H |
| 11 – 17 | 0B11H | 11 – 61 | 0B3DH | 12 – 17 | 0C11H |
| 11 – 18 | 0B12H | 11 – 62 | 0B3EH | 12 – 18 | 0C12H |
| 11 – 19 | 0B13H | 11 – 63 | 0B3FH | 12 – 19 | 0C13H |
| 11 – 20 | 0B14H | 11 – 64 | 0B40H | 12 – 20 | 0C14H |
| 11 – 21 | 0B15H | 11 – 65 | 0B41H | 12 – 21 | 0C15H |
| 11 – 22 | 0B16H | 11 – 66 | 0B42H | 12 – 22 | 0C16H |
| 11 – 23 | 0B17H | 11 – 67 | 0B43H | 12 – 23 | 0C17H |
| 11 – 24 | 0B18H | 11 – 68 | 0B44H | 12 – 24 | 0C18H |
| 11 – 25 | 0B19H | 11 – 69 | 0B45H | 12 – 25 | 0C19H |
| 11 – 26 | 0B1AH | 11 – 70 | 0B46H | 12 – 26 | 0C1AH |
| 11 – 27 | 0B1BH | 11 – 71 | 0B47H | 12 – 27 | 0C1BH |
| 11 – 28 | 0B1CH | 11 – 72 | 0B48H | 12 – 28 | 0C1CH |
| 11 – 29 | 0B1DH | 11 – 73 | 0B49H | 12 – 29 | 0C1DH |
| 11 – 30 | 0B1EH | | | 12 – 30 | 0C1EH |
| 11 – 31 | 0B1FH | | | 12 – 31 | 0C1FH |
| 11 – 32 | 0B20H | | | 12 – 32 | 0C20H |
| 11 – 33 | 0B21H | | | 12 – 33 | 0C21H |
| 11 – 34 | 0B22H | | | 12 – 34 | 0C22H |
| 11 – 35 | 0B23H | | | 12 – 35 | 0C23H |
| 11 – 36 | 0B24H | | | 12 – 36 | 0C24H |
| 11 – 37 | 0B25H | | | 12 – 37 | 0C25H |
| 11 – 38 | 0B26H | | | 12 – 38 | 0C26H |
| 11 – 39 | 0B27H | | | 12 – 39 | 0C27H |
| 11 – 40 | 0B28H | | | 12 – 40 | 0C28H |
| 11 – 41 | 0B29H | | | 12 – 41 | 0C29H |
| 11 – 42 | 0B2AH | | | 12 – 42 | 0C2AH |
| 11 – 43 | 0B2BH | | | 12 – 43 | 0C2BH |

| Function | Register No | Function | Register No | Function | Register No |
|---|---|---|---|---|---|
| Group 12 | | Group 13 | | Group 13 | |
| 12 – 44 | 0C2CH | 13 – 00 | 0D00H | 13 – 44 | 0D2CH |
| 12 – 45 | 0C2DH | 13 – 01 | 0D01H | 13 – 45 | 0D2DH |
| 12 – 46 | 0C2EH | 13 – 02 | 0D02H | 13 – 46 | 0D2EH |
| 12 – 47 | 0C2FH | 13 – 03 | 0D03H | 13 – 47 | 0D2FH |
| 12 – 48 | 0C30H | 13 – 04 | 0D04H | 13 – 48 | 0D30H |
| 12 – 49 | 0C31H | 13 – 05 | 0D05H | 13 – 49 | 0D31H |
| 12 – 50 | 0C32H | 13 – 06 | 0D06H | 13 – 50 | 0D32H |
| 12 – 51 | 0C33H | 13 – 07 | 0D07H | 13 – 46 | 0D2EH |
| 12 – 52 | 0C34H | 13 – 08 | 0D08H | 13 – 47 | 0D2FH |
| 12 – 53 | 0C35H | 13 – 09 | 0D09H | 13 – 48 | 0D30H |
| 12 – 54 | 0C36H | 13 – 10 | 0D0AH | 13 – 49 | 0D31H |
| 12 – 55 | 0C37H | 13 – 11 | 0D0BH | 13 – 50 | 0D32H |
| 12 – 56 | 0C38H | 13 – 12 | 0D0CH | | |
| 12 – 57 | 0C39H | 13 – 13 | 0D0DH | | |
| 12 – 58 | 0C3AH | 13 – 14 | 0D0EH | | |
| 12 – 59 | 0C3BH | 13 – 15 | 0D0FH | | |
| 12 – 60 | 0C3CH | 13 – 16 | 0D10H | | |
| 12 – 61 | 0C3DH | 13 – 17 | 0D11H | | |
| 12 – 62 | 0C3EH | 13 – 18 | 0D12H | | |
| 12 – 63 | 0C3FH | 13 – 19 | 0D13H | | |
| 12 – 64 | 0C40H | 13 – 20 | 0D14H | | |
| 12 – 65 | 0C41H | 13 – 21 | 0D15H | | |
| 12 – 66 | 0C42H | 13 – 22 | 0D16H | | |
| 12 – 67 | 0C43H | 13 – 23 | 0D17H | | |
| 12 – 68 | 0C44H | 13 – 24 | 0D18H | | |
| 12 – 69 | 0C45H | 13 – 25 | 0D19H | | |
| 12 – 70 | 0C46H | 13 – 26 | 0D1AH | | |
| 12 – 71 | 0C47H | 13 – 27 | 0D1BH | | |
| 12 – 72 | 0C48H | 13 – 28 | 0D1CH | | |
| 12 – 73 | 0C49H | 13 – 29 | 0D1DH | | |
| 12 – 74 | 0C4AH | 13 – 30 | 0D1EH | | |
| 12 – 75 | 0C4BH | 13 – 31 | 0D1FH | | |
| 12 – 76 | 0C4CH | 13 – 32 | 0D20H | | |
| 12 – 77 | 0C4DH | 13 – 33 | 0D21H | | |
| 12 – 78 | 0C4EH | 13 – 34 | 0D22H | | |
| 12 – 79 | 0C4FH | 13 – 35 | 0D23H | | |
| 12 – 80 | 0C50H | 13 – 36 | 0D24H | | |
| | | 13 – 37 | 0D25H | | |
| | | 13 – 38 | 0D26H | | |
| | | 13 – 39 | 0D27H | | |
| | | 13 – 40 | 0D28H | | |
| | | 13 – 41 | 0D29H | | |
| | | 13 – 42 | 0D2AH | | |
| | | 13 – 43 | 0D2BH | | |

| Function | Register No | Function | Register No | Function | Register No |
|---|---|---|---|---|---|
| **Group 17** | | **Group 18** | | | |
| 17 – 00 | 1100H | 18 – 00 | 1200H | | |
| 17 – 01 | 1101H | 18 – 01 | 1201H | | |
| 17 – 02 | 1102H | 18 – 02 | 1202H | | |
| 17 – 03 | 1103H | 18 – 03 | 1203H | | |
| 17 – 04 | 1104H | 18 – 04 | 1204H | | |
| 17 – 05 | 1105H | 18 – 05 | 1205H | | |
| 17 – 06 | 1106H | 18 – 06 | 1206H | | |
| 17 – 07 | 1107H | | | | |
| 17 – 08 | 1108H | | | | |
| 17– 09 | 1109H | | | | |
| 17 – 10 | 110AH | | | | |
| 17 – 11 | 110BH | | | | |
| 17 – 12 | 110CH | | | | |
| 17 – 13 | 110DH | | | | |
| 17 – 14 | 110EH | | | | |
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| Function | Register No | Function | Register No | Function | Register No |
|---|---|---|---|---|---|
| Group 19 | | Group 20 | | Group 21 | |
| 19 – 00 | 1300H | 20 – 00 | 1400H | 21 – 00 | 1500H |
| 19 – 01 | 1301H | 20 – 01 | 1401H | 21 – 01 | 1501H |
| 19 – 02 | 1302H | 20 – 02 | 1402H | 21 – 02 | 1502H |
| 19 – 03 | 1303H | 20 – 03 | 1403H | 21 – 03 | 1503H |
| 19 – 04 | 1304H | 20 – 04 | 1404H | 21 – 04 | 1504H |
| 19 – 05 | 1305H | 20 – 05 | 1405H | 21 – 05 | 1505H |
| 19 – 06 | 1306H | 20 – 06 | 1406H | 21 – 06 | 1506H |
| 19 – 07 | 1307H | 20 – 07 | 1407H | 21 – 07 | 1507H |
| | | 20 – 08 | 1408H | 21 – 08 | 1508H |
| | | 20 – 09 | 1409H | | |
| | | 20 – 10 | 140AH | | |
| | | 20 – 11 | 140BH | | |
| | | 20 – 12 | 140CH | | |
| | | 20 – 13 | 140DH | | |
| | | 20 – 14 | 140EH | | |
| | | 20 – 15 | 140FH | | |
| | | 20 – 16 | 1410H | | |
| | | 20 – 17 | 1411H | | |
| | | 20 – 18 | 1412H | | |
| | | 20 – 19 | 1413H | | |
| | | 20 – 20 | 1414H | | |
| | | 20 – 21 | 1415H | | |
| | | 20 – 22 | 1416H | | |
| | | 20 – 23 | 1417H | | |
| | | 20 – 24 | 1418H | | |
| | | 20 – 25 | 1419H | | |
| | | 20 – 26 | 141AH | | |
| | | 20 – 27 | 141BH | | |
| | | 20 – 28 | 141CH | | |
| | | 20 – 29 | 141DH | | |
| | | 20 – 30 | 141EH | | |
| | | 20 – 31 | 141FH | | |
| | | 20 – 32 | 1420H | | |
| | | 20 – 33 | 1421H | | |
| | | 20 – 34 | 1422H | | |
| | | 20 – 35 | 1423H | | |