

Illuminance Meter T-10A

Communication Specifications



KONICA MINOLTA

Konica Minolta, Inc.
Optics Company, Sensing Business Unit
3-91, Daisennishimachi, Sakai-ku, Sakai-shi, Osaka, JAPAN
<http://www.konicaminolta.com/selector/instruments.html>

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Notes regarding these specifications:

- An understanding of the fundamentals of PC communication is assumed in the preparation of this document. This document was prepared to explain communication procedures specific to the stated product.
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Revision (Date)	Modifications
Rev. 1.00 (January 31, 2012)	First English version
Rev. 1.02 (September 5, 2013)	<ul style="list-style-type: none">• Correction of mistake in sample code on p. 10• Change of company name

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1 Introduction

This document explains how to communicate with the Illuminance Meter T-10A (hereafter referred to as "T-10A") via USB, and the procedures for controlling the instrument through such communication. Please read this manual thoroughly before using the T-10A connected to a PC, and follow the instructions herein. Improper operation may result in unexpected results.

- For connecting the T-10A with a PC, use the exclusive Communication Cable T-A15 (sold separately).
- The commands listed herein can also be used for communication with the T-10 via RS-232C using the exclusive Communication Cable T-A11 (sold separately) for connection with a PC. However, operation of the T-10 using the commands herein has not been thoroughly verified.

1.1 About the USB driver for T-10A

Communication between a computer and a T-10A is performed via a virtual COM port. In order to perform such control, it is necessary to install the USB device driver.

The USB device driver for the T-10A is located in the Drivers folder of the downloaded files.

- The USB device driver is a device driver from Future Technology Devices International Ltd. (FTDI) and operation has been verified utilizing the device driver version included on the downloaded files. However, if you would prefer to use the latest version of the device driver, please visit the FTDI homepage at: <http://www.ftdichip.com/> Please note however that operation with versions other than the version included on the downloaded files has not been verified.

2 Main body control examples

- How to perform communication is explained on p. 20, and the details of the communication commands are explained starting on p. 25.
- Meaning of symbols:

→	Command sent from the PC to the T-10A
←	Command sent from the T-10A to the PC
+	Combination of characters
␣	Space (20h)
" "	Character string (ASCII code)
[STX]	STX [02h]
[ETX]	ETX [03h]
[BCC]	Block Check Character (See p. 25 for details.)
[DELIMITER]	Delimiter code CR+LF [0Dh+0Ah]

2.1 Reading Measurement Data into the PC

2.1.1 Procedure

- The T-10A takes measurements at 500msec intervals. Therefore, operation from the PC involves repeatedly reading the most recent measurement data into the PC.
- When specifying the receptor head number when sending commands, if only one receptor head is used the receptor head number should be set to "00". However, when an extension cable is used, the receptor head number set using the rotary switch on the receptor adapter should be used. (See the T-10A instruction manual for details.)
- When using multiple receptor heads, set the receptor head number for each head to different numbers using the rotary switch on each receptor adapter. Be sure that no duplicate receptor head numbers are set. (See the T-10A instruction manual for details.)
- When receiving a response from the T-10A, be sure to check that the BCC is correct. If the BCC is incorrect, repeat the process which caused the error.

- 1 Connect the PC, T-10A, and each receptor head, and switch on the T-10A.
 - After the T-10A starts up, it will automatically perform zero calibration.
 - After "CAL" has disappeared from the T-10A's display, proceed to step 2.

- If the connection status of the receptor heads change, the T-10A power should be switched off momentarily and then switched back on, and this procedure repeated again.

- 2 Switch the T-10A to PC connection mode. (Command "54")

(See p. 31 for command details.)

PC	T-10A
[STX]+"00541_ _ _ _"+[ETX]+[BCC]+[DELIMITER] →	
← [STX]+"0054_ _ _ _"+[ETX]+[BCC]+[DELIMITER]	

- In order to perform communication with a PC, this command must be used to set the T-10A to PC connection mode.
- Check that the response from the T-10A is correct.
- If no response is received, resend the command. If there is still no response, check that the cable is properly connected, and repeat the procedure from step 1.
- Wait at least 500ms before proceeding to step 3.
- After waiting, clear the send and receive buffers.

- 3 Set measurement conditions. (Command "10")

(See p. 26 for command details.)

PC	T-10A
[STX]+"00100200"+[ETX]+[BCC]+[DELIMITER]	→
	← [STX]+"00100_30+_6214"_____"+ [ETX]+[BCC]+[DELIMITER]
[STX]+"01100200"+[ETX]+[BCC]+[DELIMITER]	→
	← [STX]+"01100_30+_6214"_____"+ [ETX]+[BCC]+[DELIMITER]
(Repeat for each receptor head number.)	

•
•

- This command sets the CCF function and range of the receptor head. Refer to p. 26 for details of command "10". (In the above example, the CCF function is disabled, and the range is set to Auto.)
- Settings should be made with Hold setting set to RUN.
- The set conditions will become effective starting with the next measurement. Note that the data received in response to this command are data measured using the previous conditions.
- After receiving the response from the T-10A, check that the ERR and BA bytes of STATUS is correct. However, if the Measurement Value Over error occurs, it is not a problem for this step and can be ignored; proceed to the next step.
- Before proceeding to step 4, wait at least the following wait times according to the measurement range setting:
 "0" (Auto range): 3 sec.
 "1" to "5" (Manual range): 1 sec.
 (Time required to change to the appropriate range)

4 Read in measurement data. (Command "10")

(See p. 26 for command details.)

PC	T-10
[STX]+"00100200"+[ETX]+[BCC]+[DELIMITER]	→
	← [STX]+"00100_30+_6214_["+ [ETX]+[BCC]+[DELIMITER]
[STX]+"01100200"+[ETX]+[BCC]+[DELIMITER]	→
	← [STX]+"01100_30+_6214_["+ [ETX]+[BCC]+[DELIMITER]
<i>(Repeat for each receptor head number.)</i>	
	•
	•

- The most recent measurement value (illuminance, illuminance difference, or illuminance percent) will be read into the PC.
- After receiving the response from the T-10A, check that the ERR and BA bytes of STATUS are correct.
- Refer to p. 21 for details of the measurement values.
- When taking continuous measurements, send this command repeatedly at the desired timing.
- When auto range is being used, the T-10A will automatically change the measuring range depending on the amount of light. In addition, when the range is changed, the internal measurement value will not be changed, and the previous measurement value will continue to be held. Therefore, when the light changes so that the measurement range may be changed around the time the measurement data is read, the measurement value prior to the range change will be read.
- For stable, high-accuracy measurements of various measurement subjects, check the range information for each measurement, and discard measurement data obtained immediately after the range changes. Refer to p. 26 for details of command "10".
- When reading measurement values from the same receptor head, the interval between reading measurement values should be set to at least 500ms. (Since the T-10A takes measurements at 500ms intervals, setting a shorter interval time will cause the same measurement value to be read more than once.)

- If a problem occurs because the next measurement is automatically taken while the current measurement value is being read (such as when several receptor heads are used for multi-point measurement), you can set the receptor heads to Hold status and then read the measurement values. This can be done as follows:
 - 1 Perform the above procedure up to step 3.
 - 2 At the desired timing for reading the measurement, set Hold status (using command "55").
 - 3 Read the measurement value using the command "10". However, be sure to set the Hold status to on (HOLD = "1"). In the
- To cancel PC connection mode on the T-10A, set the T-10A power switch to OFF.

2.1.2 Visual Basic 6.0 Program Example

Code

```

Option Explicit
Public strSndCommand As String           'command
Public strRcvCommand As String
Public strSendStr As String              'character
Public strReceiveStr As String

Public strSTX_Command As String          'STX & command
Public strCommand_ETX As String          'command & ETX
Public strCommand_ETX_BCC As String      'command & ETX & BCC

Public intErrNO As Integer                'Error No

Public intErrflg As Integer
Public intStopFlg as Integer

Public strData As String                  'measurement data Block

Public strData1 As String
Public strData2 As String
Public strData3 As String

Public sngData1 As Single                 'measurement data Ev
Public sngData2 As Single                 'measurement data x
Public sngData3 As Single                 'measurement data y

Public i As Integer                       'for LOOP

'*****
'*** Starting Measurement ***
'*****
Private Sub cmdStartButton_Click()
    dim rng as Integer

    intErrflg = 0
'-----
'Step 2 PC MODE
'-----
    strSndCommand = "00541  "
    Call CmdSend(1)
    Call ErrCheck
    If intErrflg = 1 Then
        GoTo SubEnd
    End If
    'Insert code to wait 500ms here
    DoEvents
'-----
'Step 3 SET CONDITION
'-----
    strSndCommand = "00100200"
    Call CmdSend(1)
    Call ErrCheck

```

```

    If intErrflg = 1 Then
        GoTo SubEnd
    End If
    DoEvents
    'Insert code to wait 3s here
    intStopFlg = 0
'-----
'Step 4 READ MEASUREMENT DATA
'-----
    rng = 0
    Do While intStopFlg = 0
        strSndCommand = "00100200"
        Call CmdSend(1)
        Call ErrCheck
        If intErrflg = 1 Then
            GoTo SubEnd
        End If

        If (CInt(Mid(strRcvCommand, 7, 1)) <> rng) Then
            'When changing the measurement range, the first measurement data
            'after the change should not be used.
            rng = CInt(Mid(strRcvCommand, 7, 1))
        Else
            strData = Right(strRcvCommand, 18)

            strData1 = Left(strData, 6)
            strData2 = Mid(strData, 7, 6)
            strData3 = Right(strData, 6)

            'Ev,deltaEv,%
            sngData1 = Val(Left(strData1, 5)) * 10 ^ (Val(Right(strData1, 1)) - 4)
            sngData2 = Val(Left(strData2, 5)) * 10 ^ (Val(Right(strData2, 1)) - 4)
            sngData3 = Val(Left(strData3, 5)) * 10 ^ (Val(Right(strData3, 1)) - 4)
        End If

        DoEvents
        'When taking continuous measurements, insert code to wait 3s here.
    Loop

SubEnd:
End Sub

'*****
'*** Send command & Receive command ***
'*****
Public Sub CmdSend(FlgTimeoutCheck As Integer)
    Dim sngStartTime As Single
    Dim sngFinishTime As Single
    Dim varBuf As String

    intErrNO = 0
    strRcvCommand = ""
    strReceiveStr = ""
'-----
'Transmission
'-----
    Call BCC_Append(strSndCommand)
    strSendStr = Chr(2) & strCommand_ETX_BCC & vbCr & vbLf

```

```

'Insert code for sending data here

'-----
'Reception & TimeOut Check
'-----

'Insert code to handle data receiving within timeout limit here

'-----
'BCC Check
'-----

strSTX_Command = Left(strReceiveStr, (InStr(1, strReceiveStr, Chr(3)) - 1))

strRcvCommand = Mid(strSTX_Command, 2)
Call BCC_Append(strRcvCommand)

If (strReceiveStr) <> (Chr(2) & strCommand_ETX_BCC & vbCr & vbLf) Then
    intErrNO = 9                                'BCC Error
Else
    intErrNO = 0
End If
End Sub

'*****
'***  BCC Calculation  ***
'*****
Public Sub BCC_Append(Command As String)
    Dim intBCC As Long
    Dim strBCC As String

    strCommand_ETX = Command & Chr(3)

    intBCC = 0
    For i = 1 To Len(strCommand_ETX)
        intBCC = intBCC Xor Asc(Mid(strCommand_ETX, i, 1))
    Next i

    strBCC = (Hex(intBCC))
    If Len(strBCC) = 1 Then
        strBCC = "0" & strBCC
    Else
        End If

    strCommand_ETX_BCC = strCommand_ETX & strBCC
End Sub

'*****
'***  Error Check  ***
'*****
Public Sub ErrCheck()
    If Mid(strRcvCommand, 8, 1) = "1" Then
        intErrNO = 11                                'Battery Out
        Exit Sub
    ElseIf intErrNO = 0 Then
        If Mid(strRcvCommand, 6, 1) = " " Then
            intErrNO = 0
        End If
    End If
End Sub

```

```
Else
    intErrNO = Val(Mid(strRcvCommand, 6, 1))
End If
End If

Select Case intErrNO
    Case 0: Exit Sub
    Case 1: MsgBox "POWER OF SENSOR WAS OFF." : intErrflg = 1
    Case 2: MsgBox "EE-PROM ERROR" : intErrflg = 1
    Case 3: MsgBox "EE-PROM ERROR" : intErrflg = 1
    Case 5: Exit Sub
    Case 7: Exit Sub
    Case 8: MsgBox "TIME OUT" : intErrflg = 1
    Case 9: MsgBox "BCC ERROR" : intErrflg = 1
    Case 11: MsgBox "BATTERY OUT" : intErrflg = 1
End Select
End Sub
```

2.2 Reading Integrated Data into the PC

2.2.1 Procedure

- The T-10A takes measurements and updates the integrated data at 500msec intervals. Therefore, operation from the PC involves resetting the integrated measurement repeatedly reading the most recent measurement data into the PC.
- When specifying the receptor head number when sending commands, if only one receptor head is used the receptor head number should be set to "00". However, when an extension cable is used, the receptor head number set using the rotary switch on the receptor adapter should be used. (See the T-10A instruction manual for details.)
- When using multiple receptor heads, set the receptor head number for each head to different numbers using the rotary switch on each receptor adapter. Be sure that no duplicate receptor head numbers are set. (See the T-10A instruction manual for details.)
- When receiving a response from the T-10A, be sure to check that the BCC is correct. If the BCC is incorrect, repeat the process which caused the error.

1 Connect the PC, T-10A, and each receptor head, and switch on the T-10A.

- After the T-10A starts up, it will automatically perform zero calibration.
- After "CAL" has disappeared from the T-10A's display, proceed to step 2.

- If the connection status of the receptor heads change, the T-10A power should be switched off momentarily and then switched back on, and this procedure repeated again.

2 Switch the T-10A to PC connection mode. (Command "54")

(See p. 31 for command details.)

PC	T-10A
[STX]+"00541_ _ _ _"+[ETX]+[BCC]+[DELIMITER] →	
	← [STX]+"0054_ _ _ _"+[ETX]+[BCC]+[DELIMITER]

- In order to perform communication with a PC, this command must be used to set the T-10A to PC connection mode.
- Check that the response from the T-10A is correct.
- If no response is received, resend the command. If there is still no response, check that the cable is properly connected, and repeat the procedure from step 1.
- Wait at least 500ms before proceeding to step 3.
- After waiting, clear the send and receive buffers.

3 Set measurement conditions. (Command "11")

(See p. 28 for command details.)

PC	T-10A
[STX]+"00110200"+[ETX]+[BCC]+[DELIMITER] →	
	← [STX]+"00110_30+_6214" _ _ _ _ _ _ _ _ _ _"+ [ETX]+[BCC]+[DELIMITER]
[STX]+"01110200"+[ETX]+[BCC]+[DELIMITER] →	

← [STX]+"01110_30+_6214"_____"+" [ETX]+[BCC]+[DELIMITER]
<i>(Repeat for each receptor head number.)</i>
•
•

- This command sets the CCF function and range of the receptor head. Refer to p. 28 for details of command "11". (In the above example, the CCF function is disabled, and the range is set to Auto.)
- Settings should be made with Hold setting set to RUN.
- The set conditions will become effective starting with the next measurement. Note that the data received in response to this command are data measured using the previous conditions.
- After receiving the response from the T-10A, check that the ERR and BA bytes of STATUS is correct. However, if the Measurement Value Over error occurs, it is not a problem for this step and can be ignored; proceed to the next step.
- Before proceeding to step 4, wait at least the following wait times according to the measurement range setting:
 "0" (Auto range): 3 sec.
 "1" to "5" (Manual range): 1 sec.
 (Time required to change to the appropriate range)

4 Set the T-10A to Hold status. (Command "55")

(See p. 32 for command details.)

PC	T-10A
[STX]+"99551_0" + [ETX]+[BCC]+[DELIMITER] →	
	← (No response)

- To make all the receptor heads start integration simultaneously, set all heads to Hold status.
- Wait at least 500ms before proceeding to step 5.

5 Clear the past integrated data. (Command "28")

(See p. 30 for command details.)

PC	T-10
[STX]+"0028_0000" + [ETX]+[BCC]+[DELIMITER] →	
	← [STX] +"0028_0000" + [ETX]+[BCC]+[DELIMITER]
[STX]+"0128_0000" + [ETX]+[BCC]+[DELIMITER] →	
	← [STX] +"0128_0000" + [ETX]+[BCC]+[DELIMITER]
<i>(Repeat for each receptor head number.)</i>	
	•
	•

- This command clears past integrated data from the measuring heads
- After receiving the response from the T-10A, check that the ERR byte of STATUS is correct.

6 Start integration. (Command "55")

(See p. 32 for command details.)

PC	T-10A
[STX]+"99550_0"+[ETX]+[BCC]+[DELIMITER] →	
← (No response)	

- Release the Hold status to start integration.
- Send the command at the time you want to start integration.
- Wait at least 500ms before proceeding to step 7.

7 End integration. (Command "55")

(See p. 32 for command details.)

PC	T-10
[STX]+"99551_0"+[ETX]+[BCC]+[DELIMITER] →	
← (No response)	

- Set the Hold status to end integration.
- Send the command at the time you want to stop integration.
- Wait at least 500ms before proceeding to step 8.

8 Read in measurement data. (Command "11")

(See p. 28 for command details.)

PC	T-10A
[STX]+"00111200"+[ETX]+[BCC]+[DELIMITER] →	
← [STX]+"00100_30+_6214_++++++"+ [ETX]+[BCC]+[DELIMITER]	
[STX]+"01111200"+[ETX]+[BCC]+[DELIMITER] →	
← [STX]+"01100_30+_6214_++++++"+ [ETX]+[BCC]+[DELIMITER]	
(Repeat for each receptor head number.)	
•	
•	

- The integrated data stored in the T-10A will be read into the PC.
- After receiving the response from the T-10A, check that the parameter bytes of STATUS are correct.
- Refer to p. 21 for details of the measurement values.
- For repeated measurements, repeat steps 4 to 8.
- To cancel PC connection mode on the T-10A, set the T-10A power switch to OFF.
- To read interim measurement values or integrated data, the commands "10" or "11" can be sent while integration is being performed. To prevent interrupting integration, be sure the data are read with the Hold status set to Run (HOLD = "0").
- If this is being performed, wait at least 500ms before sending another command.

2.2.2 Visual Basic 6.0 Program Example Code

```

Option Explicit
Public strSndCommand As String           'command
Public strRcvCommand As String
Public strSendStr As String             'character
Public strReceiveStr As String

Public strSTX_Command As String         'STX & command
Public strCommand_ETX As String         'command & ETX
Public strCommand_ETX_BCC As String     'command & ETX & BCC

Public intErrNO As Integer              'Error No

Public intErrflg As Integer
Public intStopFlg As Integer

Public strData As String                'measurement data Block

Public strData1 As String
Public strData2 As String
Public strData3 As String

Public sngData1 As Single               'measurement data Ev
Public sngData2 As Single               'measurement data x
Public sngData3 As Single               'measurement data y

Public SensorNo
Public m As Integer                    'number of sensor
Public n As Integer

Public i As Integer                    'for LOOP
Public j As Integer                    'for LOOP

'*****
'*** Starting Measurement ***
'*****
Private Sub cmdStartButton_Click()
    intErrflg = 0
    '-----
    'Step 2 PC MODE
    '-----
    strSndCommand = "00541  "
    Call CmdSend(1)
    Call ErrCheck
    If intErrflg = 1 Then
        Exit Sub
    End If
    'Insert code to wait 500ms here
    DoEvents
    '-----
    'Step 3 SET CONDITION
    '-----
    strSndCommand = "00110200"
    Call CmdSend(1)
    Call ErrCheck
    If intErrflg = 1 Then

```



```

        GoTo SubEnd
    End If
    DoEvents
    'Insert code to wait 3s here
'-----
'Step 4 HOLD ON
'-----
    strSndCommand = "99551 0"
    Call CmdSend(0)
    'Insert code to wait 500ms here
    DoEvents
'-----
'Step 5 RESET DATA
'-----
    strSndCommand = "0028  "
    Call CmdSend(1)
    Call ErrCheck
    If intErrflg = 1 Then
        GoTo SubEnd
    End If
    DoEvents
'-----
'Step 7 HOLD OFF
'-----
    intStopFlg = 0
    strSndCommand = "99550 0"
    Call CmdSend(0)
    DoEvents
    'Insert code to wait 500ms here
'-----
'Step 8 Read Measurement Data
'-----
    Do While intStopFlg = 0
        strSndCommand = "00110200"
        Call CmdSend(2)           'TimeOut Check * 3
        Call ErrCheck
        If intErrflg = 1 Then
            GoTo SubEnd
        End If

        strData = Right(strRcvCommand, 18)

        strData1 = Left(strData, 6)
        strData2 = Mid(strData, 7, 6)
        strData3 = Right(strData, 6)

        'sigumaLv,T,sigumaLv/T
        sngData1 = Val(Left(strData1, 5)) * 10 ^ (Val(Right(strData1, 1)) - 4)
        sngData2 = Val(Left(strData2, 5)) * 10 ^ (Val(Right(strData2, 1)) - 4)
        sngData3 = Val(Left(strData3, 5)) * 10 ^ (Val(Right(strData3, 1)) - 4)

        DoEvents
        'Insert code to wait 500ms here
    Loop

Exit Sub

SubEnd:
End Sub

```

```

'*****
'***  Send command & Receive command  ***
'*****
Public Sub CmdSend(FlgTimeoutCheck As Integer)
    Dim sngStartTime As Single
    Dim sngFinishTime As Single
    Dim varBuf As String

    intErrNO = 0
    strRcvCommand = ""
    strReceiveStr = ""

'-----
'Transmission
'-----
    Call BCC_Append(strSndCommand)
    strSendStr = Chr(2) & strCommand_ETX_BCC & vbCr & vbLf
    'Insert code for sending data here

'-----
'Reception & TimeOut Check
'-----
    'Insert code to handle data receiving within timeout limit here

'-----
'BCC Check
'-----
    strSTX_Command = Left(strReceiveStr, (InStr(1, strReceiveStr, Chr(3)) - 1))

    strRcvCommand = Mid(strSTX_Command, 2)
    Call BCC_Append(strRcvCommand)

    If (strReceiveStr) <> (Chr(2) & strCommand_ETX_BCC & vbCr & vbLf) Then
        intErrNO = 9                'BCC Error
    Else
        intErrNO = 0
    End If
End Sub

'*****
'***  BCC Calculation  ***
'*****
Public Sub BCC_Append(Command As String)
    Dim intBCC As Long
    Dim strBCC As String

    strCommand_ETX = Command & Chr(3)

    intBCC = 0
    For i = 1 To Len(strCommand_ETX)
        intBCC = intBCC Xor Asc(Mid(strCommand_ETX, i, 1))
    Next i

    strBCC = (Hex(intBCC))
    If Len(strBCC) = 1 Then
        strBCC = "0" & strBCC
    Else

```

```
End If

strCommand_ETX_BCC = strCommand_ETX & strBCC
End Sub

'*****
'*** Error Check ***
'*****

Public Sub ErrCheck()
    If Mid(strRcvCommand, 8, 1) = "1" Then
        intErrNO = 11 'Battery Out
        Exit Sub
    ElseIf intErrNO = 0 Then
        If Mid(strRcvCommand, 6, 1) = " " Then
            intErrNO = 0
        Else
            intErrNO = Val(Mid(strRcvCommand, 6, 1))
        End If
    End If

    Select Case intErrNO
        Case 0: Exit Sub
        Case 1: MsgBox "POWER OF SENSOR WAS OFF." : intErrflg = 1
        Case 2: MsgBox "EE-PROM ERROR" : intErrflg = 1
        Case 3: MsgBox "EE-PROM ERROR" : intErrflg = 1
        Case 5: Exit Sub
        Case 7: Exit Sub
        Case 8: MsgBox "TIME OUT" : intErrflg = 1
        Case 9: MsgBox "BCC ERROR" : intErrflg = 1
        Case 11: MsgBox "BATTERY OUT" : intErrflg = 1
    End Select
End Sub
```

3 Reference

3.1 Communication method

- The communication parameters for the T-10A are as shown in the table below. Set the PC to these parameters.

Parameter	Details
Communication method	Start/stop synchronization; Half duplex
Baud rate	9600bps (fixed)
Character length	7 bits
Parity	Even
Stop bits	1 bit
Delimiter code	CR+LF

- Commands from the PC to the T-10A and command responses from the T-10A are fixed-length strings (ASCII code).
- Half-duplex communication is used. Because of this, when sending a series of commands, it is necessary to receive the command response (including the delimiter code) from the instrument for each command and wait the specified length of time before sending the next command. However, certain commands do not provide a command response.
- Use the exclusive Communication Cable T-A15 (sold separately) for connecting the T-10A to a PC.

3.2 Communication format

- The T-10A uses two types of communication formats: Short and Long.
- The Long format is used only for the command responses (T-10A -> PC) for commands 10 and 11. All other commands and command responses use the Short communication format.

3.2.1 Short communication format

STX (1)	Receptor head # (2)	Command (2)	Status/Parameter (4)	ETX (1)	BCC (2)	CR (1)	LF (1)
02h				03h		0Dh	0Ah

- Numbers in parentheses indicate number of characters

STX	1 byte	Start of text (02h; fixed)
Receptor head number	2 bytes	
Command name	2 bytes	
PARAMETER/STATUS	4 bytes	Parameter data for commands; Status data for command responses.
ETX	1 byte	End of text (03h; fixed)
BCC	2 bytes	XOR (exclusive OR) of the data up to ETX (excluding STX). See p. 24 for details regarding BCC.
CR	1 byte	Carriage return (0Dh; fixed)
LF	1 byte	Line feed (0Ah; fixed)

- Delimiter code is fixed as CR+LF (0Dh + 0Ah).

3.2.2 Long communication format

- The Long format is the same as the Short format, with the addition of Data bytes.
- Details of items other than Data are the same as those for the Short format.
- Data is used in determining the BCC.
- Data contains the measurement values (6 columns × 3 values) in the format shown below.

STX (1)	Receptor head # (2)	Command (2)	Status (4)	Data (6 × 3 blocks)	ETX (1)	BCC (2)	CR (1)	LF (1)
02h					03h		0Dh	0Ah

1 block of data					
Sign	Value	Value	Value	Value	Exp.

Repeated for remaining 2 blocks.

- The meaning of each parameter for Data is shown below.
- Sign

Character	"+" (2Bh)	"-" (2Dh)	"=" (3Dh)
Meaning	+	-	±

- Numerical values
Significant digits: 4

- Exponent

Character	"0"	"1"	"2"	"3"	"4"	"5"	"6"	"7"	"8"	"9"
Meaning	10^{-4}	10^{-3}	10^{-2}	10^{-1}	10^0	10^1	10^2	10^3	10^4	10^5

Measurement value examples

0.001

"+"	"0"	"0"	"0"	"1"	"1"
-----	-----	-----	-----	-----	-----

-0.0001

"-"	"0"	"0"	"0"	"1"	"0"
-----	-----	-----	-----	-----	-----

123

"+"	␣	"1"	"2"	"3"	"4"
-----	---	-----	-----	-----	-----

±0

"="	␣	␣	␣	"0"	"0"
-----	---	---	---	-----	-----

9876×10³

"+"	"9"	"8"	"7"	"6"	"7"
-----	-----	-----	-----	-----	-----

␣ indicates a space (20h).

3.2.3 BCC

The BCC (Block Check Character) of the T-10A is obtained by successively XORing (taking the exclusive or of) the message bytes starting from the first Head No. byte and ending with the final data byte (final DATA byte, if a short message, or final DATA1 byte, if a long message), with the result expressed as a 2-byte ASCII value. The BCC can be checked to verify the reliability of the communication data. When sending a command from the PC to the T-10A, be sure to set the BCC correctly. If the BCC is set incorrectly, the T-10A will not respond. When receiving data from the T-10A, the BCC should be checked, and if the value is incorrect, the response from the instrument is invalid and is not reliable.

About "Exclusive OR":

Exclusive OR is a boolean logic operation in which the result is 0 if the 2 bits are the same, and 1 if they are different. So, for example,

0 and 0 would be 0

1 and 0 would be 1

1 and 1 would be 0

BCC setting example

For this example, the following command will be sent:

Command 02 (read colorimetric measurement values) is being sent to receptor head 01. CF function is disabled, and calibration mode is set to NORM.

STX (1)	Receptor head # (2)		Command (2)		Parameter (4)				ETX (1)	BCC (2)		CR (1)	LF (1)
02h	"0"	"1"	"1"	"0"	"0"	"2"	"0"	"0"	03h			0Dh	0Ah

- 20h is used for space.

Contents	ASCII	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Receptor head # (10's)	30h	0	0	1	1	0	0	0	0
Receptor head # (1's)	31h	0	0	1	1	0	0	0	1
Command (10's)	31h	0	0	1	1	0	0	0	1
Command (1's)	30h	0	0	1	1	0	0	0	0
Parameter (byte 1)	30h	0	0	1	1	0	0	0	0
Parameter (byte 2)	32h	0	0	1	1	0	0	1	0
Parameter (byte 3)	30h	0	0	1	1	0	0	0	0
Parameter (byte 4)	30h	0	0	1	1	0	0	0	0
ETX	03h	0	0	0	0	0	0	1	1

Results

XOR	01h	0	0	0	0	0	0	0	1
-----	-----	---	---	---	---	---	---	---	---

After conversion to ASCII, the following values would be set:

BCC upper character	BCC lower character
"0" (30h)	"1" (31h)

And the command would become:

STX (1)	Receptor head # (2)		Command (2)		Parameter (4)				ETX (1)	BCC (2)		CR (1)	LF (1)
02h	"0"	"1"	"1"	"0"	"0"	"2"	"0"	"0"	03h	"0"	"1"	0Dh	0Ah

3.3 Explanation of commands

The following are the commands which can be used.

Command type	Command	Reference page
Read measurement data (illuminance, Δ illuminance, percent)	10	26
Read integrated data (Σ illuminance, time, Σ illuminance/time)	11	28
Clear integrated data	28	30
Set PC connection mode	54	31
Set Hold status	55	32

3.3.1 Read measurement data (Illuminance, Δ Illuminance, Percent): Command 10

Function

To read the most recent measurement data (illuminance, Δ illuminance, percent) from the T-10A to the PC.

- The command does not cause a measurement to be taken upon being received by the T-10A.

Command format/parameter explanation (PC->T-10A)

Receptor head #		Command		Parameter			
		"1"	"0"	HLD	CCF	RNG	"0"
①				②	③	④	

- Grayed parameters are fixed.

Number	Contents	Details/Range
①	Receptor head #	"00" to "29": Receptor head number The number set using the rotary switches on each receptor head adapter prior to switching on the T-10A (See the T-10A Instruction Manual.)
②	HOLD function	"0": RUN "1": HOLD
③	CCF function	"2": CCF disabled "3": CCF enabled
④	Range setting	"0": Auto range "1": 0.00 to 29.99 (lx) "2": 0.0 to 299.9 (lx) "3": 0 to 2999 (lx) "4": 0 ₀ to 2999 ₀ (lx) "5": 0 ₀₀ to 2999 ₀₀ (lx)

Command response format/status explanation (T-10A->PC)

Receptor head #		Command		Status				Data		
		"1"	"0"	HLD	ERR	RNG	BA	Illum.	Δ Illum.	%
①				②	③	④	⑤	⑥		

- Grayed parameters are fixed.

Number	Contents	Details/Range	
①	Receptor head #	"00" to "29"	
②	HOLD setting	"0", "2", "4", "6": RUN "1", "3", "5", "7": HOLD	
③	ERR: Error information		Normal operation
		"1"	Receptor head power is switched off. Switch off the T-10A and then switch it back on, and repeat the procedure from the beginning.
		"2"	EEPROM error 1 Switch off the T-10A and then switch it back on, and repeat the procedure from the beginning.
		"3"	EEPROM error 2 Switch off the T-10A and then switch it back on, and repeat the procedure from the beginning.
		"5"	Measurement value over error Displayed when the measurement exceed the T-10A measurement range. If this error occurs, the measurement values should not be used as the values for the most recent measurement. If this error occurs repeatedly, reduce the luminance or increase the distance between the light source and measuring instrument.
		"7"	Normal operation
④	RNG: Range	"1" to "5" (as listed on previous page). If the range is changed from the range for the immediately previous data, the data should be discarded and the next data should be used. In the following example, data 2 occurs just after the range has changed from R2 to R3, so data 2 should be discarded and data 1, 3, and 4 should be used. [1] [2] [3] [4] R2 → R3 → R3 → R3 <u>This procedure is necessary to ensure stable, high-accuracy measurements of various measurement</u>	
⑤	BA: Battery level	"0", "2"	Normal
		"1", "3"	Low battery The battery should be changed immediately or the AC adapter should be used. Also, if this error occurs, the measurement values should not be used as the values for the most recent measurement.
⑥	Measurement values	Illuminance, Δ Illuminance, Percent (For details of how to read the data, refer to p. 22.) The reference used for Δ illuminance and percent is the reference illuminance set on the T-10A, and must be set beforehand. If no reference illuminance is set, the values for Δ illuminance and percent will be spaces.	

3.3.2 Read integration data (Σ Illuminance, Time, Σ Illuminance/Time): Command 11

Function

To read the most recent integration data ((Σ Illuminance, Time, Σ Illuminance/Time) from the T-10A to the PC.

- The command does not cause a measurement to be taken upon being received by the T-10A.

Command format/parameter explanation (PC->T-10A)

Receptor head #	Command		Parameter			
	"1"	"1"	HLD	CCF	RNG	"0"
①			②	③	④	

- Grayed parameters are fixed.

Number	Contents	Details/Range
①	Receptor head #	"00" to "29": Receptor head number The number set using the rotary switches on each receptor head adapter prior to switching on the T-10A (See the T-10A Instruction Manual.)
②	HOLD function	"0": RUN "1": HOLD
③	CCF function	"2": CCF disabled "3": CCF enabled
④	Range setting	"0": Auto range "1": 0.00 to 29.99 (lx) "2": 0.0 to 299.9 (lx) "3": 0 to 2999 (lx) "4": 0 ₀ to 2999 ₀ (lx) "5": 0 ₀₀ to 2999 ₀₀ (lx)

Command response format/status explanation (T-10A->PC)

Receptor head #	Command		Status				Data		
	"1"	"1"	HLD	ERR	RNG	BA	ΣIllum.	Time	ΣIllum./T
①			②	③	④	⑤	⑥		

- Grayed parameters are fixed.

Number	Contents	Details/Range	
①	Receptor head #	"00" to "29"	
②	HOLD setting	"0", "2", "4", "6": RUN "1", "3", "5", "7": HOLD	
③	ERR: Error information	▼	Normal operation
		"1"	Receptor head power is switched off. Switch off the T-10A and then switch it back on, and repeat the procedure from the beginning.
		"2"	EEPROM error 1 Switch off the T-10A and then switch it back on, and repeat the procedure from the beginning.
		"3"	EEPROM error 2 Switch off the T-10A and then switch it back on, and repeat the procedure from the beginning.
		"5"	Measurement value over error Displayed when the measurement exceed the T-10A measurement range. If this error occurs, the measurement values should not be used as the values for the most recent measurement. If this error occurs repeatedly, reduce the luminance or increase the distance between the light source and measuring instrument.
		"7"	Normal operation
④	RNG: Range	"1" to "5"	
⑤	BA: Battery level	"0", "2"	Normal
		"1", "3"	Low battery The battery should be changed immediately or the AC adapter should be used. Also, if this error occurs, the measurement values should not be used as the values for the most recent measurement.
⑥	Measurement values	□Illuminance, Time, □Illuminance/Time (For details of how to read the data, refer to p. 22.)	

3.3.3 Clear integration data: Command 28

Function

Clears the integration data stored in the T-10A.

Command format/parameter explanation (PC->T-10A)

Receptor head #	Command		Parameter			
	"2"	"8"				

①

- Grayed parameters are fixed.

Number	Contents	Details/Range
①	Receptor head #	"00" to "29": Receptor head number The number set using the rotary switches on each receptor head adapter prior to switching on the T-10A (See the T-10A Instruction Manual.)

Command response format/status explanation (T-10A->PC)

Receptor head #	Command		Status			
	"2"	"8"		ERR		

①

②

- Grayed parameters are fixed.

Number	Contents	Details/Range	
①	Receptor head #	"00" to "29"	
②	ERR: Error information	↓	Normal operation
		"1"	Receptor head power is switched off. Switch off the T-10A and then switch it back on, and repeat the procedure from the beginning.
		"2"	EEPROM error 1 Switch off the T-10A and then switch it back on, and repeat the procedure from the beginning.
		"3"	EEPROM error 2 Switch off the T-10A and then switch it back on, and repeat the procedure from the beginning.
		"5"	Normal operation
		"7"	Normal operation

3.3.4 Set PC connection mode: Command 54

Function

Switches T-10A to PC connection mode.

- In normal mode, the T-10A will not accept any commands other than this one.

Command format/parameter explanation (PC->T-10A)

Receptor head #		Command		Parameter			
"0"	"0"	"5"	"4"	"1"	▬	▬	▬

- All parameters are fixed.
- The receptor head number is fixed at "00".

Command response format/status explanation (T-10A->PC)

Receptor head #		Command		Status			
"0"	"0"	"5"	"4"	▬	▬	▬	▬

- All parameters are fixed.

3.3.5 Set Hold status: Command 55

Function

Sets the T-10A to Hold status.

- Wait at least 500ms after receiving the command response before sending further commands.

Command format/parameter explanation (PC->T-10A)

Receptor head #		Command		Parameters			
"9"	"9"	"2"	"8"	HOLD	↓	↓	"0"

①

- Grayed parameters are fixed.
- The receptor head number is fixed at "99".

Number	Contents	Details/Range
①	HOLD function	"0": RUN "1": HOLD

Command response format/status explanation (T-10A->PC)

No response will be sent.

3.4 Error Codes

Code	Meaning	Details
␣ (space)	Normal	No error (normal)
"1"	POW-ON	Indicates that power to the head has been cut off. Turn the T-10A off and then back on.
"2"	EEPROM error 1	An improper value has been written to the receptor head's EEPROM. Turn the T-10A power off and then back on. If the problem recurs, the unit requires service.
"3"	EEPROM error 2	
"5"	Measurement value over error	<p>Displayed when a range has been selected manually and the measurement exceeds the selected measurement range. Change to a higher range and take the measurement again. If this error occurs with the highest range selected, the measurement exceeds the T-10A measurement range. If this error occurs repeatedly, reduce the luminance or increase the distance between the light source and measuring instrument.</p> <p>If this error occurs when Auto Range is selected, the measurement exceeds the maximum measuring range of the T-10A. If this error occurs repeatedly, reduce the luminance or increase the distance between the light source and measuring instrument.</p> <p>Furthermore, if this error occurs, the output values will be the measurement values from the previous measurement, and should not be used.</p>