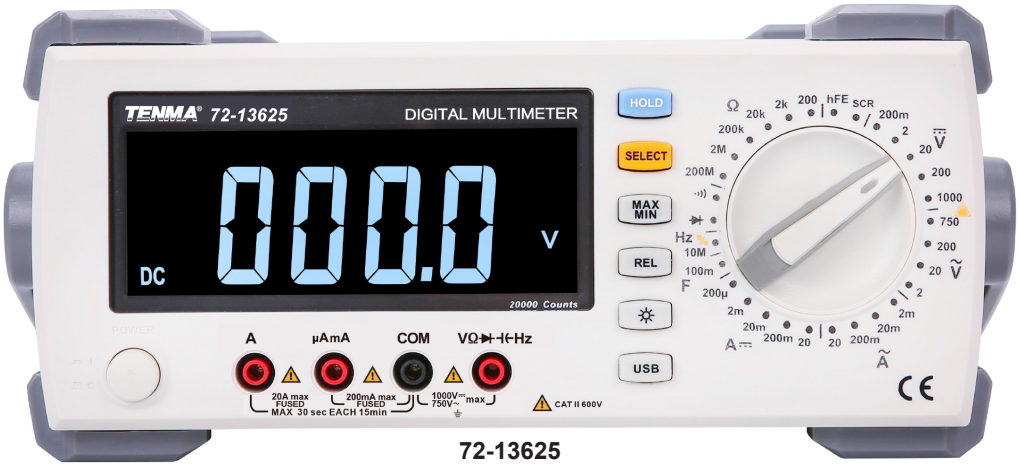
True RMS Bench Top Digital Multimeter

Programming Manual

72-13620



72-13625

Part Number: 72-13620 & 72-13625

Statement

Support model

Part Number	Physical Interface	Communication Interface	VID & VID	Instrument Address
72-13625	USB	HID	0x10c4&0xea80	[C:DM][D:T8802][T:HID][PID:0xea80][VID:0x10c4]
72-13620			0x10c4&0xea80	[C:DM][D:T8803][T:HID][PID:0xea80][VID:0x10c4]

Drive Description

The instrument with USB-HID communication interface is free-drive. If the instrument with USB-HID connect with computer by USB line, it recognize that is USB serial port, please unload the drive and then use HID drive.

Acquisition Device:

Query Instrument

Use query interface of UCI library to query which device connect with computer:

a) uci_QueryNodes

b) uci_QueryNodesX

Select suitable interface to process query device, the detailed description of query interface and example code refer to {UCI Help Document.pdf) or see the example project in examples files.

When filling in the device query information, you should add the device VID and PID if you want to query. For VID and PID of each model, please see the table in the section “Supported Models” .

Notes: query currently only support the device based on HID communication, COM communication does not yet add in query system.

Insert in/out notification of subscribe device

If you just want to know the device status of plug and unplug, and then do the corresponding logical operations, like turn on/off it. You can use subscription mechanism of uci plug and unplug instead of periodically querying the device to know whether the device is online. The relevant uci interface, please refer to (UCI Help Document.pdf) for the interface description of *uci_SetAttribute and uci_SetNotify.*

Instruction Set:

All the command text are not case-sensitive.

Data? – Read the current test data

Command Name	IO	Data	Description
data?;	Read only	Double (8 Bytes)	Read the current test data

Interface:

Use read data interface

Disp? – Read display information

Command Name	IO	Data	Description
disp?;	Read only	Double (8 Bytes)	Read the current test data and status information, that is reading display on the screen.

Data Structure:

```
//@brief : data frame of multimeter and millivoltmeter
//@remark:
struct DMFRM {
    //@brief : the main display character string (20 characters)
    TCHAR MainDisp[20];
    //@brief : the secondary display character string or □20 characters□
    TCHAR AuxDisp[20];
    //@brief : the main display numeric value□8Bytes□
    double MainValue;
    //@brief : the secondary display numeric value□8Bytes□
    double AuxValue;
    //@brief : flag bit (8 Bytes)
    unsigned long long Flags;
};
```

The definition of TCHAR as follows:

Coding Scheme	Definition	Description
UNICODE	wchar_t	16 bits UNICODE coding characters
ASCII	char	8 bits ASCII coding characters

The specific is wchar_t or char, it is based on compiling environment and uci.dll version.

Distinction:

Comparative Mode	Data?	Disp?
Data	Double (8 Bytes)	struct DMFRM
Query status code	uci_Read\ uci_ReadX interface returns value>0, that is status code The detailed see the description of read data interface	DMFR.Flags is status code□the meaning of each bit refer to status bit list
Applications	It requires that acquire test value of floating point number and simple status information	It requires that data type of floating point number, the similar data display on the screen and status information

Interface

Read data:

u_status uci_Read(u_session _session, PRParams _params, u_byte* _data, u_size _dataLen);
u_status uci_ReadX(u_session _session, u_cstring _msg, u_uint32 _timeout, u_byte* _data, u_size _dataLen);
the detailed description of interface, please refer to (UCI Help File.pdf) and this is the description of returns value

Returns Value	Meaning
<0	Error codr
>0	“Data?”: status bit coding, it need to turn to 32 bits without symbol integer and then to parse it, the detailed see Status bit list
	“disp?” : it presents the data quantity of read, that is the size of DMFRM structure body (Bytes)
=0	This result is not exist.

Example
Test 72-13625 in VC with UNICODE environment:

```
struct DMFRM
{
	TCHAR MainDisp[20];
	TCHAR AuxDisp[20];
	double MainValue;
	double AuxValue;
	unsigned long long Flags;
};
Notes: TCHAR is wide character in UNICODE environment, that is one character two bytes;
#define Bits(_status, _offset, _mask) ((_status >> _offset) & _mask)
std::wstring& GetUnit(unsigned char _type, unsigned char _scale, std::wstring& _s)
{
std::wstring unit[] = {
	_T("V"), _T("A"), _T("Ω"), _T("Hz"), _T("°C"), _T("°C"),
	_T(" "), _T("F"), _T("β"), _T("%"), _T(" ")
};
std::wstring scale[] = {
	_T("n"), _T("μ"), _T("m"), _T(" "), _T("k"), _T("M"), _T("G"), _T(" ")
};
	_s = _T("");
	if (_scale < sizeof(scale) / sizeof(scale[0]))
		_s += scale[_scale];
	if (_type < sizeof(unit) / sizeof(unit[0]))
		_s += unit[_type];
	return _s;
}
void _main_UT8802N_cpp()
{
	double dv = 0.0;
	DMFRM dfrm;
////////////////////////////////////disp?////////////////////////////
//read
u_status r = uci_ReadX(m_session, _T("disp?;"), 2000,
	(unsigned char*)&dfrm, sizeof(dfrm));
if (r <= 0)
{
	_tprintf(_T("[read : disp?]Error, r = %d; msg = %s\n"),
	   r, uci_GetLastError());
	return;//error
}
//parse
unsigned char unit_scale = Bits(dfrm.Flags, 8, 0xf);
unsigned char unit_type = Bits(dfrm.Flags, 12, 0x7);
std::wstring str_unit;
GetUnit(unit_scale, unit_type, str_unit);
```

```
//show
_tprintf(_T("disp? : main = %s, aux = %s, mv = %f %s, av = %f, flags = 0x%x\n"),
      dfrm.MainDisp, dfrm.AuxDisp,
      dfrm.MainValue, str_unit.c_str(), dfrm.AuxValue, dfrm.Flags);

////////////////////////////////data?////////////////////////////
r = uci_ReadX(m_session, _T("data?;"), 2000, (unsigned char*)&dv, sizeof(dv));
if (r <= 0)
{
      _tprintf(_T("[read : data?]Error, r = %d; msg = %s\n"), r, uci_GetLastError());
      return;//error
}
      unit_scale = Bits(dfrm.Flags, 8, 0xf);
      unit_type = Bits(dfrm.Flags, 12, 0x7);
      GetUnit(unit_scale, unit_type, str_unit);
      _tprintf(_T("data? : value = %f %s, flags = 0x%x\n"),
            dv, str_unit.c_str(), dfrm.Flags);
}
```

72-13625 instrument displayed: 50.23 Hz

Programming print:

disp? : main = 50.23, aux = , mv = 50.230000 Hz, av = 0.000000, flags = 0x2013345

data? : value = 50.230000 Hz, flags = 0x2013345

Appendix

Status Bit List

"common"status bit list is suitable for all models.

Common

Bit	Digit	Meaning	Data
D0~D3	4	Functional coding	See Coding Table
D4~D5	2	AC&DC status	See Coding Table
D6	1	Whether it is Auto Range	0:no; 1:yes
D7	1	Wheter it is Over load	0:no; 1:yes
D8~D11	4	Physical unit type	See Coding Table
D12~D14	3	Physical unit magnitude	See Coding Table
D15	1	Whether it is low battery	0:no; 1:yes
D16	1	Whether it is USB communication	0:no; 1:yes
D17	1	Whether it is Under status	0:no; 1:yes
D18	1	Whether it is Over status	0:no; 1:yes
D19	1	Whether it is display minus symbol	0:no; 1:display
D20~D23	4	Position coding	See Coding Table: only use when it necessary.
D24~D27	4	Scalling position	The scalling position start from 1
D28	1	Whether it is MAX	0:no; 1:yes {apply to 72-13620\72-13625}
D29	1	Whether it is MIN	0:no; 1:yes {apply to 72-13620\72-13625}

Bit	Digit	Meaning	Data
D30	1	Whether it is relative measurement value(REL)	0:no; 1:yes {apply to 72-13620\72-13625}
D31	1	Whether it is data hold(HOLD)	0:no; 1:yes {apply to 72-13620\72-13625}

DMFR.Flags High 32 bits Status Bit List

This coding table is only apply to 72-13620\72-13625

Bit	Digit	Meaning	Data
D0	1	Error flag	1:the current data error or the current display Err
D1	1	Test mode of L , C position	1:serial mode, screen display SEL; 0:parallel mode, screen display PAL
D2	1	Diode, thyristor direction pointing => from right to left	1 : valid, 0 : invalid
D3	1	Diode, thyristor direction pointing => from left to right	1 : valid, 0 : invalid
D4	1	Inductance quality element measurement	1:yes; 0:no;
D5	1	Equivalent resistance measurement	1:yes; 0:no;
D6	1	Capacitance loss element measurement	1:yes; 0:no;
D7	1	Capacitance - equivalent resistance measurement	1:yes; 0:no;
D8~D15	8	position	The detailed see: 72-13620 functional coding and 72-13625 functional coding
D16~D31	16	Hold	
D31	1	Whether it is data hold(HOLD)	0:no; 1:yes {apply to 72-13620\72-13625}

Functional Coding Table

There is common bit coding table and the specific model coding table, these two type can present all the position of model, please choose according to the actual situation.

Common

This functional coding table is apply to all models.

Type	Coding
Voltage measurement (Voltage)	0
Resistance measurement (OHM)	1
Diode measurement (DIODE)	2
Circuit continuit measurement (Continuity)	3
Capacitance measurement (Capacitance)	4
Frequency (FREQ)	5
Temperature measurement Fahrenheit degree (TEMPERATURE FAHRENHEIT)	6
Temperature measurement Centigrade (TEMPERATURE CENTIGRADE)	7
Triode hFE measurement, unit is β (hFE)	8

Type	Coding
Current measurement (Current)	9
%(4-20mA)	10
Duty ratio measurement (Duty)	11
Thyristor measurement (SCR)	12
Inductance measurement (including Q :“Inductance quality element measurement”,R :“equivalent resistance”)	13

Notes

Functional coding does not divided into DCV, ACV,DCV+ACV or DCI, ACI, DCI+ACI, but it abstract to voltage and current. It can differentiate category by AC&DC status code and unit type. Other category can also differentiate by flag, such as Q,R test of inductance measurement, it has single flag to distinguish.

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This functional coding table is only apply to 72-13620, data from flag bit D8~D15 in DMFR.Flags high 32 bits of command “disp?”.

Position	Coding
AC voltage measurement (ACV)	0
DC current measurement (DCV)	1
AC current microampere position (ACμA)	2
AC current milliampere position (AC mA)	3
AC current standard position (AC A)	4
DC current microampere position (DCμA)	5
DC current milliampere position (DC mA)	6
DC current standard position (DC A)	7
Resistance measurement (OHM)	8
Circuit continuity measurement (Continuity)	9
Diode measurement (DIODE)	10
Inductance measurement (L)	11
Inductance measurement (Q)	12
Inductance measurement (R)	13
Capacitance measurement (Capacitance) (C)	14
Capacitance measurement (Capacitance) (D)	15
Capacitance measurement (Capacitance) (R)	16
Triode hFE measurement (unit is β(hFE)	17
Thyristor measurement (SCR)	18
Temperature measurement Centigrade (TEMPERATURE CENTIGRADE)	19
Temperature measurement Fahrenheit degree (TEMPERATURE FAHRENHEIT)	20
Frequency (FREQ)	21
Duty ratio measurement (Duty)	22

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This functional coding table is only apply to 72-13625, data from flag bit D8~D15 in DMFR.Flags high 32 bits of command “disp?”.

Position	Coding
AC current milliampere position (AC 2mA)	0x10
AC current milliampere position (AC 20mA)	0x13
AC current milliampere position (AC 200mA)	0x14
AC current standard position (AC 20A)	0x18
AC current microampere position (DC 200μA)	0x0D
DC current milliampere position (DC 2mA)	0x0E
DC current milliampere position (DC 20mA)	0x11
DC current milliampere position (DC 200mA)	0x12
DC current standard position (DC 2A)	0x16
Frequency (FREQ Hz)	0x2B
Frequency (FREQ kHz)	0x2C
Frequency (FREQ MHz)	0x2D
Duty ratio measurement (Duty)	0x22
Circuit continuity measurement (Continuity)	0x24
Diode measurement (DIODE)	0x23
Resistance measurement (OHM 200Ω)	0x19
Resistance measurement (OHM 2kΩ)	0x1A
Resistance measurement (OHM 20kΩ)	0x1B
Resistance measurement (OHM 200kΩ)	0x1C
Resistance measurement (OHM 2MΩ)	0x1D
Resistance measurement (OHM 200MΩ)	0x1F
Triode hFE measurement (unit is β(hFE)	0x25
Thyristor measurement (SCR)	0x2A
DC voltage measurement (200mV)	0x01
DC voltage measurement (2V)	0x03
DC voltage measurement (20V)	0x04
DC voltage measurement (200V)	0x05
DC voltage measurement (1000V)	0x06
AC voltage measurement (2V)	0x09
AC voltage measurement (20V)	0x0A
AC voltage measurement (200V)	0x0B
AC voltage measurement (750V)	0x0C
Capacitance measurement (Capacitance nF)	0x27
Capacitance measurement (Capacitance μF)	0x28
Capacitance measurement (Capacitance mF)	0x29

Coding Table of Physical Unit Type

Type	Coding
Voltage (V)	0
Current (A)	1
Resistance (Ω)	2
Frequency (Hz)	3
Centigrade (°C)	4
Fahrenheit degree (°F)	5
RPM(rpm)hold	6
capacitance (F)	7
Triode hFE	8
Percentage (%)	9
No display	0xf

Coding Table of Physical Unit Magnitude

Type	Coding
n	0
μ	1
m	2
standard	3
K	4
M	5
G	6

AC and DC Status Coding Table

Type	Coding
OFF	0
AC	1
DC	2
AC+DC	3