J2200A

Optocoupler CTR Module
User Manual

Easy Set-Up & Easy To Use

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1   <u>__Introduction__</u>

An optocoupler, also known as an opto-isolator or photocoupler, is an electronic component that allows electrical signals to be transferred between two circuits without a direct electrical connection. It consists of a light-emitting diode (LED) that is optically coupled to a photodetector, such as a phototransistor or a photodiode.

When an electrical signal is applied to the LED, it emits light that is directed toward the photodetector. The amount of light received by the photodetector is proportional to the strength of the electrical signal, and this signal is then transferred to the output circuit. Because there is no direct electrical connection between the input and output circuits, the optocoupler provides electrical isolation, which can help protect sensitive electronic components from damage caused by voltage surges or other electrical disturbances.

Optocouplers are commonly used in electronic circuits for a variety of applications, including motor control, power supply regulation, and digital communications. They are particularly useful in situations where electrical isolation is required for safety reasons or to prevent interference between circuits.

CTR stands for Current Transfer Ratio and is a parameter that describes the relationship between the input current and output current of an optocoupler or other similar devices. It is also sometimes referred to as the current gain.

The CTR is expressed as a ratio or percentage and is calculated by dividing the output current by the input current. For example, if an optocoupler has an input current of 10mA and an output current of 5mA, the CTR would be 50%.

The CTR is an important parameter because it determines the efficiency of the optocoupler in transferring electrical signals between two circuits. A higher CTR means that more of the input current is transferred to the output, resulting in a stronger and more reliable signal. It also affects the speed and accuracy of the signal transfer, as well as the power consumption of the device.

Optocouplers with high CTR values are preferred in applications where accurate signal transfer is critical, such as in medical equipment or industrial control systems. However, the CTR can vary depending on the operating conditions and other factors, so it is important to choose an optocoupler with the appropriate CTR for the specific application.

The specifications provided by the manufacturer are often simplistic, and

generally provide a limited set of DC parameters. For example, the CTR range may only be defined as "CTR 80%~160% at If=5mA, Vce= 5V."

It seems that engineers are facing a challenge in designing circuits using optocouplers, particularly on isolated feedback control circuits. The optocoupler's specifications provided by the manufacturer may not be sufficient as a reference for designing the circuit under current application conditions. Thus, engineers need to test the optocoupler under those conditions to obtain the corresponding parameters.

Moreover, optocouplers come in different types, and the CTR (current transfer ratio) rank is also varied, ranging from 50% to 600%. In addition, the manufacturer's specifications do not provide AC parameters such as $\triangle$CTR and $\triangle$ Rd, which are necessary for designing isolation feedback control circuits.

To address this issue, the J2200A is an essential tool for engineers in designing isolation feedback control circuits. It provides both AC and DC parameters of various bias voltages, making it easier for engineers to select and design the appropriate optocoupler for their circuit. However, this testing process may not be a one-time task since the optocoupler selection varies depending on the application, and engineers may need to test different optocouplers to find the most suitable one for their circuit design. The range of CTR specifications for optocouplers is also quite wide, varying from 50%~600% in some cases. Precision circuit applications may not be able to tolerance this deviation, especially since the nominal CTR is not defined.

The J2200A optocoupler test instrument provides various bias conditions for optocouplers and greatly eases the measurement of key parameters, including CTR. The J2200A provides pulse current mode measurement function, which reduces the temperature rise during the testing process improving the accuracy of the measurement.

Optocoupler procurement is often exempted from incoming component inspection, but given counterfeit products are appearing in the market, optocoupler inspection has become more necessary. The J2200A is a very convenient tool for IQC.
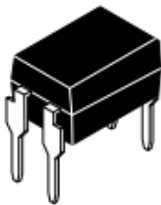
2 Device Overview

This J2200A may be used for 4-pin and 6-pin (photo-transistor type) Optocouplers only as shown below.
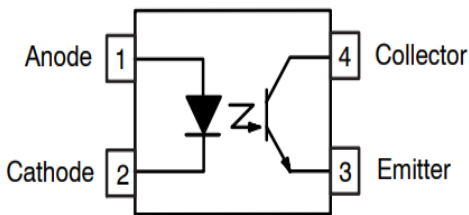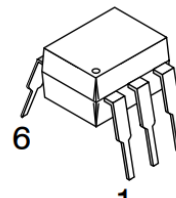
- **J2200A (top view)**
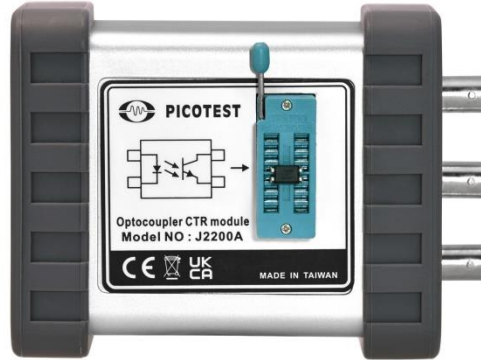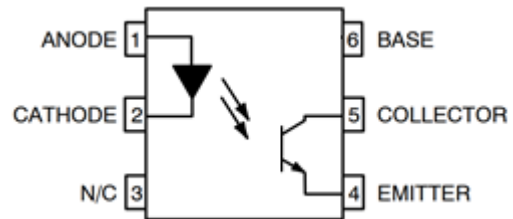

- **4-Pin Optocouplers (All Type)**
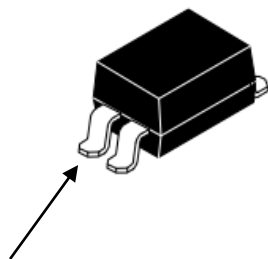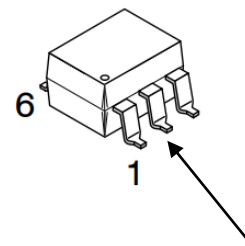- **6-Pin Optocouplers (Photo-transistor)**

SCHEMATIC

SCHEMATIC

MOC8/OX (without Base Connection)

The optocouplers with short plate feet cannot be directly inserted into the J2200A. An extension board is required to facilitate this.
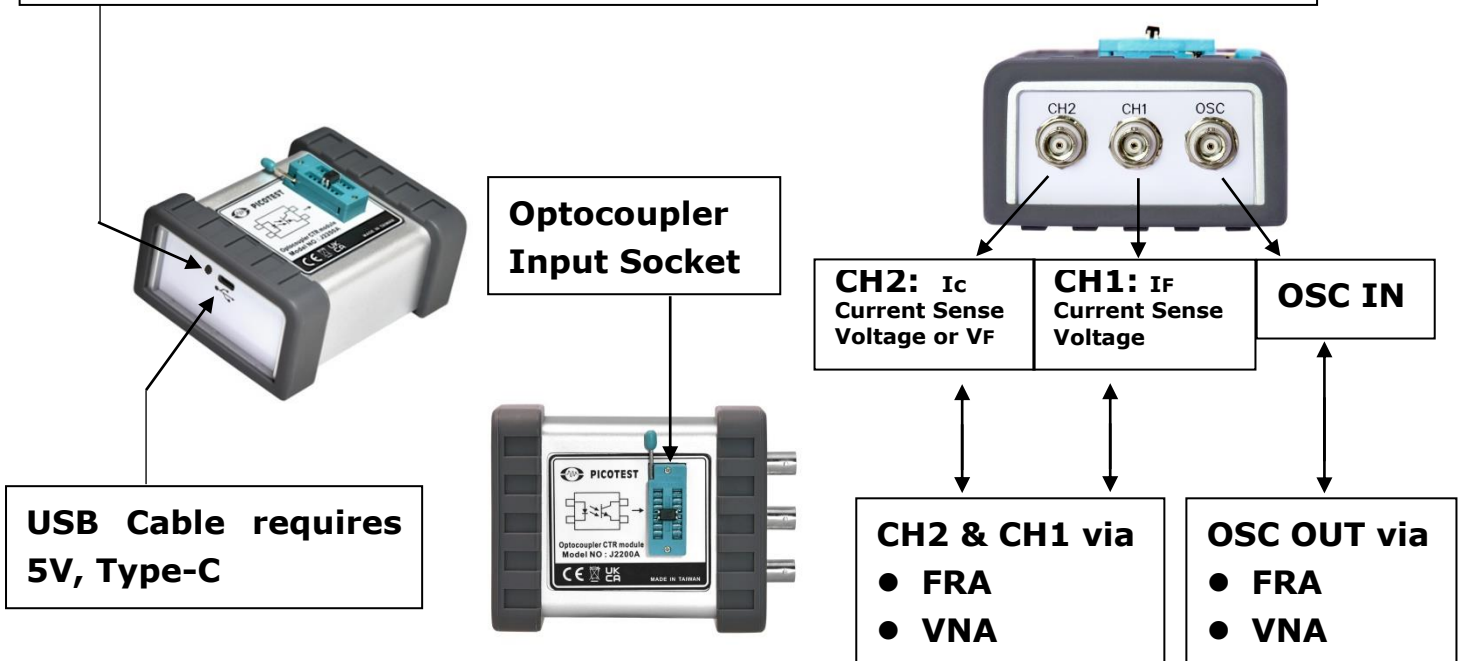

4-Pins in short-plate feet

6-Pins in short-plate feet

- **I/O Overview**

A green light indicates the J2200A is working normally with the M352XA.

The red light indicates the J2200A has a problem connecting to the M352XA.

The orange light indicates the J2200A is in the upgrading mode.

Optocoupler Input Socket

USB Cable requires 5V, Type-C

CH2: Ic Current Sense Voltage or VF	CH1: IF Current Sense Voltage	OSC IN

CH2 & CH1 via • FRA • VNA	OSC OUT via • FRA • VNA

* Note: Wiring J2200A's CH1, CH2, and OSC to the same ports on a Frequency Response Analyzer (FRA), or a VNA, is only for frequency domain measurement. For more information, please refer to the section 3.2.

● **Inserting an Optocoupler**

When testing optocouplers, only one unit can be inserted at a time, regardless of the type being tested, as shown below.
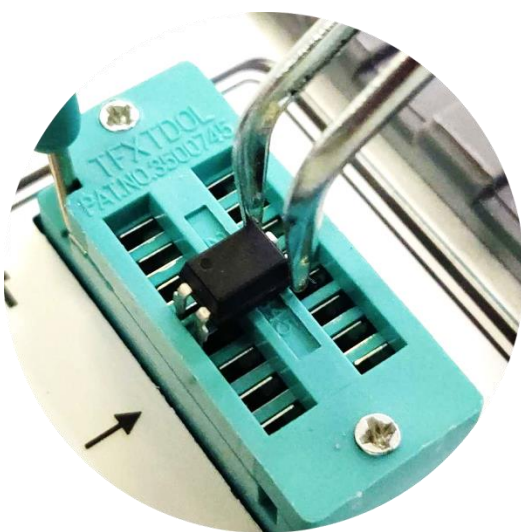
Inserting a 4-pin unit
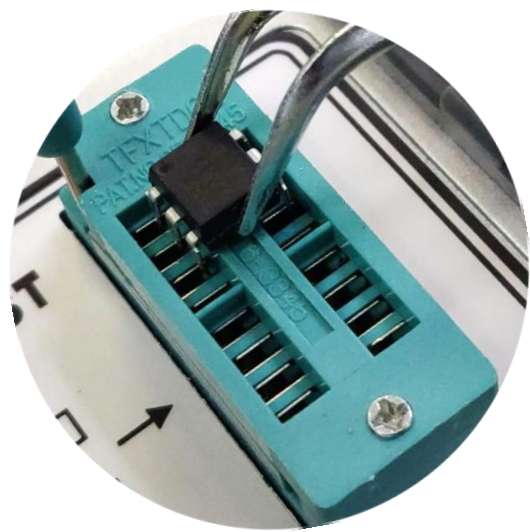
Inserting a 6-pin unit.

* Note: Note the pin insertion position.

- **Optocoupler Insertion Socket**

  When inserting an optocoupler (DUT) into the socket, either a 4-pin or a 6-pin device with a black point (yellow arrow) needs to be plugged into the yellow point of the socket. In addition, as your DUT might require a 2-pin resistor under the 6-pin optocoupler's test, you can plug in the resistor into the white points (the sockets for Pin 4 and Pin 8). When the DUT is in place, push the bar down to fasten the DUT.

DIP16

15 16	BASE
GND 9	10
7 8	
DNC 5	6 GND
GND 3	4 BASE
DNC 1	2 GND
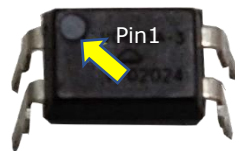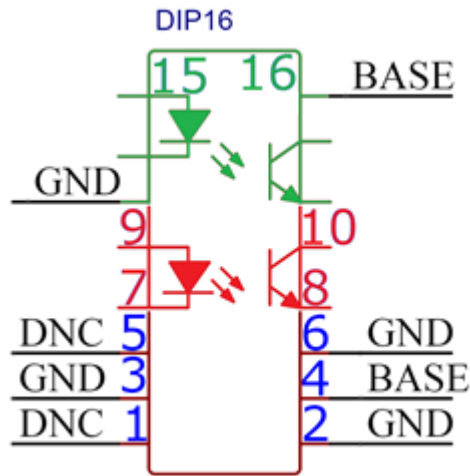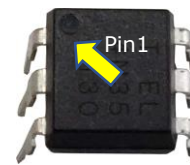
4-Pins   6-Pins

  * Note: Hot plugging for each DUT on the J2200A is allowable.

3   Measurement and Setup

At this point in time, the available GUI (Graphical User Interface) is only available on the M352XA DMM. FRA or VNA testing is defined in application notes provided by Picotest.com
(https://www.picotest.com/products_J2200A.html).

3.1 Operating with Benchtop Test Equipment

Make the connections as shown below and power on the DMM. The overall state will show up like the picture below.

3.1.1 Panel Operation

When the USB cable is connected to the M352XA and J2200A, the display will switch to the CTR mode automatically as shown below. With the factory default, the preliminary value you see on the display may be different since the correct current and voltage values on the optocoupler's data sheet haven't been entered yet..
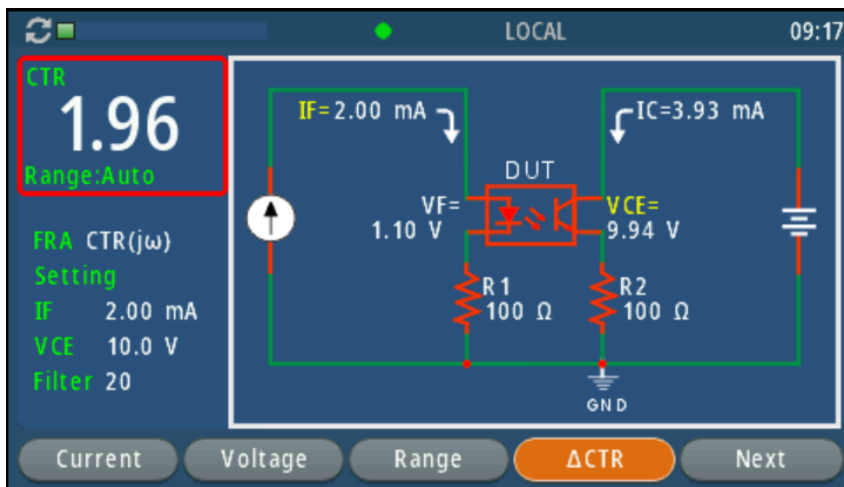
In the picture, the red frame shows the measured CTR value, and the white frame shows the dynamic DUT condition with the variations of $I_c/I_F/VCE/V_F$. At this point, you need to setup the J2200A using parameters or settings appropriate for the DUT's specifications.

* Note: The commonly-used functions are shown on the bottom of the

- Current: The target current covers I$_F$ (default) and Pulsed I$_F$.
- Voltage: The target voltage requires a voltage value.
- Range: 1mA, 10mA, 100mA, Auto(default)
- △CTR: After selection, CTR, △CTR, and△RD show up on the left at the same time. (See the picture below)
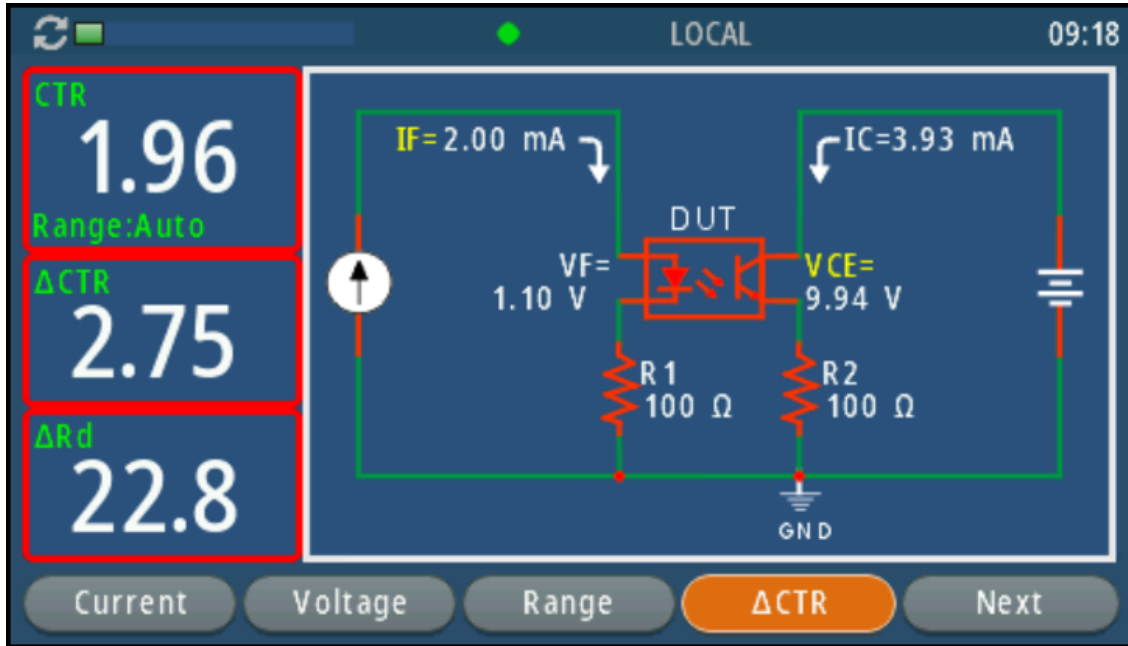
- Next: Upon the next press, the next function setup of Filter, Save, FRA, and ✳ will show up. (See the picture below)

- Filter: The value of 1 to 1000 is allowed.
- Save: The reminder of **Yes**/**No** will come up. Press **Yes** to save the changes. Press **No** to exit without saving.
- FRA: CTR(jω), Rd(jω - default)
- ✳: The detailed setup menu including the above and the others is shown next. They are Mode, Target current, Range, Target Voltage, △ CTR, Reading Format, Digits, Filter, FRA, Calibration, and CAL restore default. (See the pictures below.)
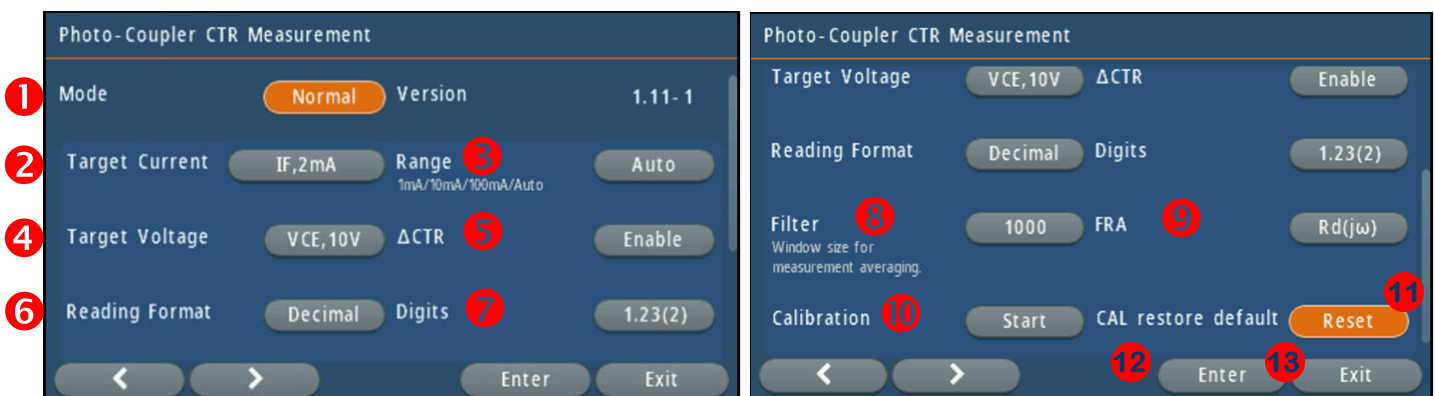
1. **Mode:** Under the normal mode, you may need to setup the following items. If disable is selected, you will exit the J2200A support menu and return to the M352XA measurement mode.
2. **Target Current:**
   50µA ~ 12mA for continue current mode
   50µA ~ 50mA for pulse current mode
3. **Range:** If there is no exact range to setup such as 1mA, 10mA, or 100mA, please leave this as "Auto".
4. **Target Voltage:** This item requires you to refer to the parts data sheet. The valid voltage is allowed to be up to 15V.
5. **△CTR:** Disable is the default. If Enable is selected, the CTR measurement will display the △CTR value as well.
6. **Reading Format:** This affects the display of the CTR measurement. Decimal, Percentage, or dB are available.
7. **Digits:** If 1.23(2) is selected the display will show two decimal places., 1.235(3) displays three decimal places.
8. **Calibration:** Selecting this will sense and remove various errors due to the setup. For more information, refer to the section 4 - Calibration.
9. **FRA:** You may select CTR(jω) or Rd(jω).
10. **CAL restore default:** Resetting causes the parts error calibration not to be taken into account, and the factory default will be recalled.
11. **Reset:** Resetting the calibration removes the previous calibrated data.
12. **Enter:** Press Enter to confirm your selections
13. **Exit:** To exit the Enter state or return to the upper menu level, press the Exit soft key or the physical Exit button.

3.1.2 CTR Measurement (Enable Pulsed Mode is Recommended)

In order to properly setup the J2200A and M352XA it is critical that you fully understand the specification of the optocoupler you would like to test. The M352XA's softkeys and knob button are mainly used to set up the J2200A.

Soft Keys   Button Knob

3.1.2.1 Data Sheet in % Presented

Given the following example from the data sheet is shown in percent, the M352XA is also required to be set to %. This setting is via the soft-key operation, Next > ✳ > Reading Format > Percentage. For instance see the VO615A-3 datasheet,.

CURRENT TRANSFER RATIO (T_{amb} = 25 °C, unless otherwise specified)

PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
I_C/I_F	① V_{CE} = 5 V, I_F = 1 mA	VO615A-1	CTR	13	30		%
		VO615A-2	CTR	22	45		%
		VO615A-3	CTR	34	70		%
		VO615A-4	CTR	56	90		%
	V_{CE} = 5 V, I_F = 5 mA	VO615A	CTR	50		600	%
		VO615A-5	CTR	50		150	%
		VO615A-6	CTR	100		300	%
		VO615A-7	CTR	80		160	%
		VO615A-8	CTR	130		260	%
		VO615A-9	CTR	200		400	%
	② V_{CE} = 5 V, I_F = 10 mA	VO615A-1	CTR	40		80	%
		VO615A-2	CTR	63		125	%
		VO615A-3	CTR	100		200	%
		VO615A-4	CTR	160		320	%

You will need to enter the test condition 5V, 1mA as marked at ❶ into the voltage and current areas. Follow the current and voltage setting procedures through the soft keys, Current > I$_F$ > 1m > Enter to set the current, and Voltage > 5V > and press Enter to set the voltage.

Please note that when selecting I$_F$, the current will continuously change on the DUT, and its temperature can rise gradually. Selecting Pulsed I$_F$ enables the intermittent current transmission. This will prevent the DUT from having any impacts due to self-heating.

In this case, after setting up the meter, the CTR value shows as 71.8%, which is close to the typical value, and a valid measurement since the value 70% on the data sheet is TYP (typical), not the MAX. If

the value 70% on the data sheet is the MAX, the a value higher than 70% would be out of spec, as would values lower than 34%. The DUT might then be treated as an out-of-spec unit.

To be cautious, we still need to test the same unit with 5V, and 10mA as marked at ❷ in order to confirm whether the tested value is valid and in range or not. The previous procedures should be repeated once again. Obtaining the value of 142%, indicates a valid value that is within the range of 100 to 200%.

If one of the test conditions, with 1mA or 10mA, does not meet the specification during inspection, then the unit would be treated as an out-of-spec unit.

3.1.2.2 Data Sheet in mA Presented

Optocoupler from different manufacturers might have different data styles or units. The PC817X3 is framed in red. It shows the model name, the rank mark, and the Ic(mA). Next to the table are the test conditions, I_F=5mA, VCE=5V.

Ordered product	Business dealing name	Rank mark	Ic (mA)
	PC817XNNIP0F	with or without	2.5 to 30
	PC817X1NIP0F	A	4.0 to 8.0
	PC817X2NIP0F	B	6.5 to 13
	PC817X3NIP0F	C	10 to 20
	PC817X4NIP0F	D	15 to 30
	PC817X5NIP0F	A or B	4.0 to 13
	PC817X6NIP0F	B or C	6.5 to 20
	PC817X7NIP0F	C or D	10 to 30
	PC817X8NIP0F	A, B or C	4.0 to 20
	PC817X9NIP0F	B, C or D	6.5 to 30
	PC817X0NIP0F	A, B, C or D	4.0 to 30

Test conditions

I_F=5mA
V_{CE}=5V
Ta=25°C

If we follow the same procedures, then we would see the value in the yellow frame, Ic = 12.2mA showing that the DUT is in good condition as per the specification. Moreover, we obtained the other important parameter CTR, 245%, as shown on the upper left side of the display.
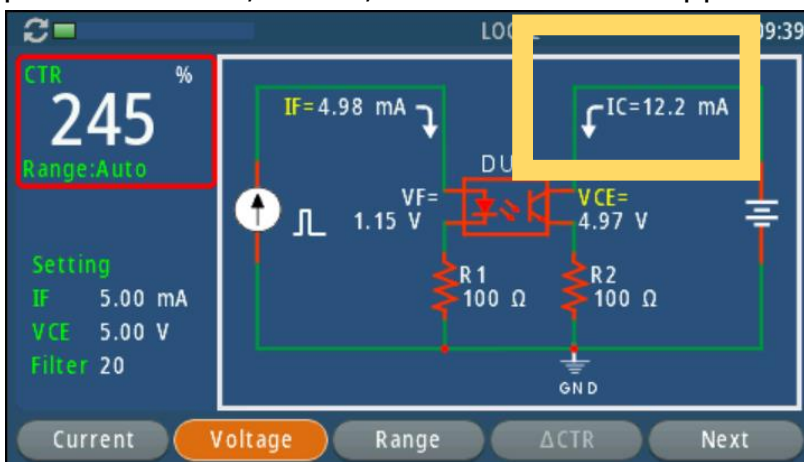
3.1.2.3 Data Sheet without Clear Information Presented

If the data sheet doesn't show parts without similar ranking information, according to V/I ranking (5V &1mA), (5V & 5mA), and (5V & 10mA), respectively, the J2200A can identify their grades, and classify them in groups.

3.1.2.4 Other Setup - Range

We suggest that you can leave the Range setting as "Auto". In that way, you can test various DUTs without knowing their current ratio characteristics. If you prefer to set up the range manually then you can obtain the most accurate response.

3.1.2.5 Other Setup - Filter

CTR values are always to run with the default filter count, 20. If you would like to see smoother and more static values, you can increase the number. The maximum number is 1000. To set it, press the soft keys Next > Filter > input a count > Enter.
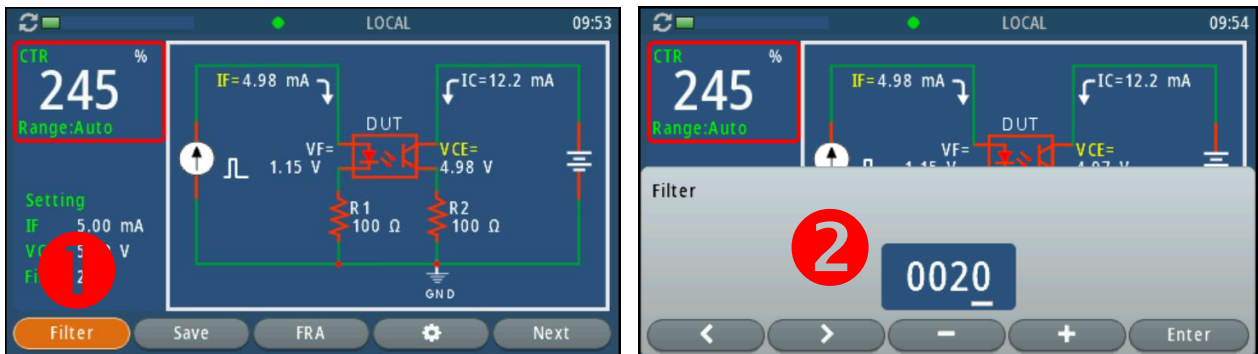
3.1.2.6 Other Setup - Save

To save the present setup, press the soft keys Next > Save to save the condition. After rebooting the M352XA, the saved setup can be recalled.
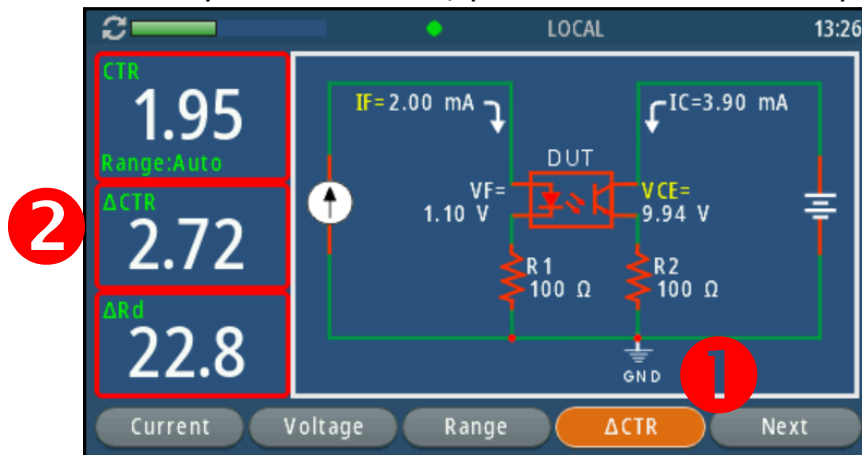
3.1.3 △CTR

△CTR is the value from the equation below.

$$\triangle CTR = \frac{\triangle I_c}{\triangle I_f}$$

When this function is selected, the display shows the following △CTR information at the middle left position. To enable this function, press the △ CTR soft key . To disable it, press the same soft key once again.
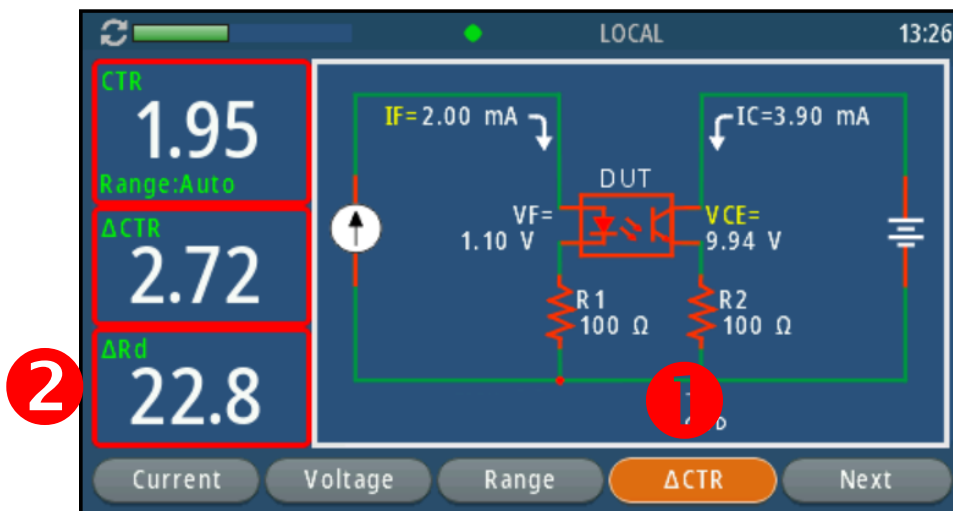

Please refer to section 3.1.1 to setup other features, according to DUT's specs.

3.1.4 △Rd

△Rd is the value from the equation below. The △Rd information is at the bottom left. To disable it, press the same soft key once again.

$$\triangle Rd = \frac{\triangle Vf}{\triangle If}$$

3.2 Operating with FRA or VNA

The required instruments for performing frequency domain meassurements are listed below.

J2200A * 1 pcs

M352XA * 1pcs

FRA * 1pcs (e.g., OMICRON Lab Bode 100 VNA)

3.2.1 Wiring over M352XA, J2200A, & FRA

Please check the Wiring Diagram below.
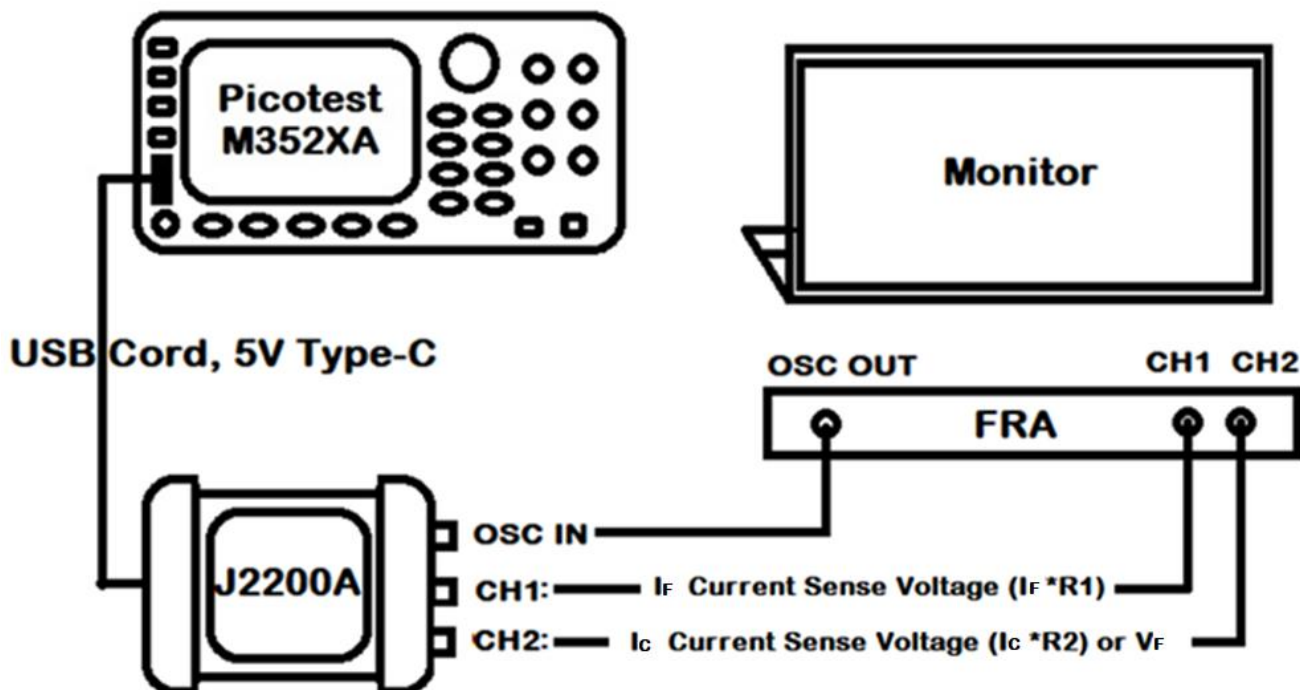
3.2.2 Setup on FRA/VNA

For FRA/VNA settings, please refer to the instrument's user's manual.

3.2.3 Setup on M352XA

When the external equipment is connected, setup CTR(jω) or Rd(jω) according to your application. To set it up, press the soft keys Next > ✳ > FRA > CTR(jω) or Rd(jω).

4 Calibration

Due to the natural aging of internal components, you may want to calibrate your J2200A.

4.1 VREF Calibration

To start the calibration, press the soft keys Next > ✳ > Calibration > Start. A reminder will pop up as shown below.

If it shows failed like the picture below, it means the connections of your test leads and Pin1/Pin2 are not in a good contact. Please reset the connections and try again.
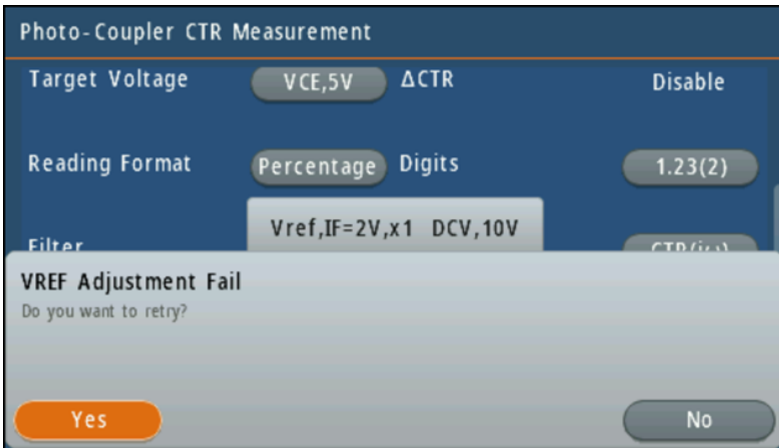
When you successfully pass the next step, you can calibrate the DAC. Remove your test lead and put your 4-Pin DUT into the proper place of the socket. Press any key to calibrate your DUT.
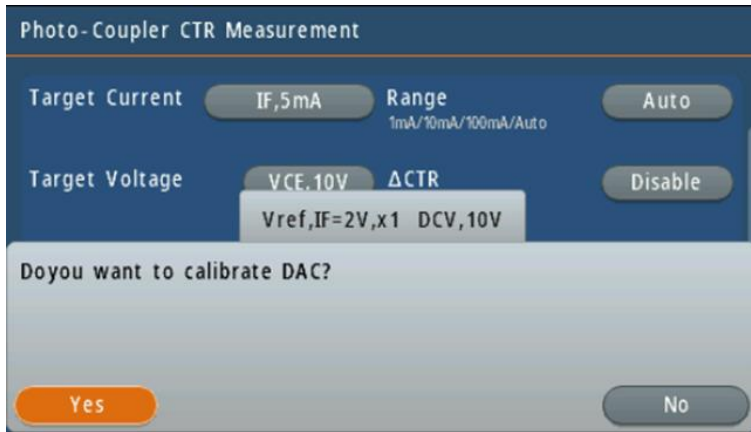
At this time calibration is only supported for 4-Pin type optocouplers. Do not use 6-Pin units for this calibration.

The calibration will adjust two current points, 1mA, and 0.1mA. When it's complete, the display will show the following message. Press any key to reboot the J2200A.
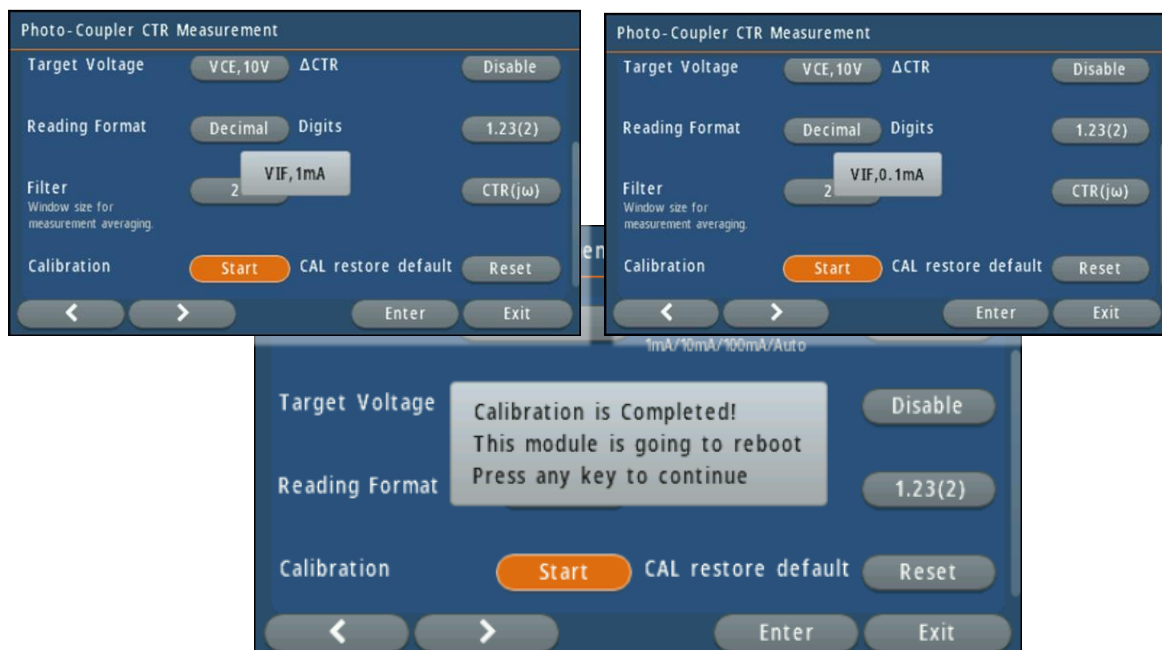
5 End up the use of J2200A

To end the use of the J2200A, unplug the USB cord from the M352XA or execute the following procedures

Next > ❋ > Disable Mode. The display will go back to the DMM measurement state.

6 Command Information

// Querying the mode of J2200, returns format as NORMal | CURVe | OFF
MODule:CTR:MODE?

// Setting the mode of J2200
MODule:CTR:MODE {NORMal|CURVe|OFF}

// Querying the VCE value of J2200, returns format as VCE,value
*Only applicable in NORMAL MODE
MODule:CTR:VOLTage? {MINimum|MAXimum|DEFault}

// Setting the VCE value of J2200 (range 0.001~15 V)
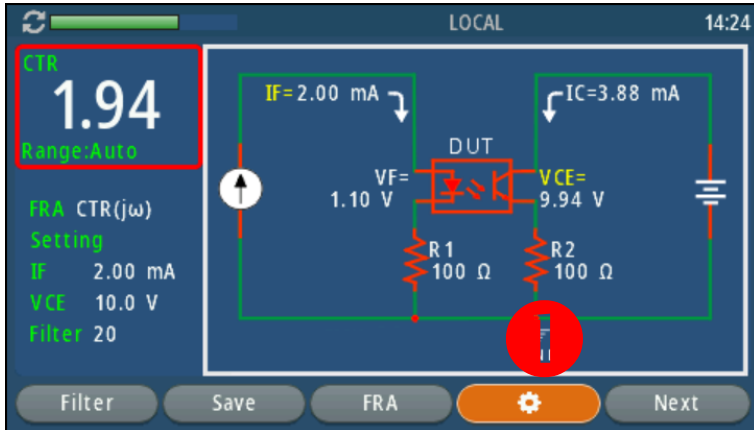*Only applicable in NORMAL MODE
MODule:CTR:VOLTage {VCE},{<value>|MINimum|MAXimum|DEFault}

// Querying the source current of J2200, returns format as IF,value or PULSE,value
*Only applicable in NORMAL MODE
MODule:CTR:SOURce:CURRent? {MINimum|MAXimum|DEFault}

// Setting the source current of J2200 (IF range 50uA12 mA, PULSE IF range 50uA60mA)
*Only applicable in NORMAL MODE
MODule:CTR:SOURce:CURRent
{IF|PULSE},{<value>|MINimum|MAXimum|DEFault}

// Querying the current range of J2200, returns format as IF range, IC range
*Only applicable in NORMAL MODE
MODule:CTR:CURRent:RANGe?

// Setting the current range of J2200
*Only applicable in NORMAL MODE
MODule:CTR:CURRent:RANGe {1|10|100|AUTO}

// Querying the number of filters set
MODule:CTR:FILTer? {MINimum|MAXimum|DEFault}

// Setting the number of filters (range 1~100)
MODule:CTR:FILTer {<value>|MINimum|MAXimum|DEFault}

// Querying the status of deltaCTR, returns format as 0|1
*Only applicable in NORMAL MODE
MODule:CTR:DELTa:[STATe]?

// Setting the activation of deltaCTR
*Only applicable in NORMAL MODE
MODule:CTR:DELTa:[STATe] {ON|OFF}

// Querying the reading format of J2200, returns format as DEC | PERC | DB
*Only applicable in NORMAL MODE
MODule:CTR:DISPlay:FORMat?

// Setting the reading format of J2200
*Only applicable in NORMAL MODE
MODule:CTR:DISPlay:FORMat {DECimal|PERCent|DB}

// Querying the fractional digits setting of J2200, returns format as 2|3
*Only applicable in NORMAL MODE
MODule:CTR:DISPlay:DIGit?

// Setting the fractional digits of J2200 (2 for two decimal places, 3 for three decimal places)
*Only applicable in NORMAL MODE
MODule:CTR:DISPlay:DIGit {2|3}

// Querying the FRA path, returns format as VIC(acCTR) | VF(acRd)
MODule:FRA:PATH?

// Setting the FRA path - PATH=VIC for acCTR; PATH=VF for acRd
MODule:FRA:PATH {VIC|VF}

// Querying the IC path resistance value
MODule:CTR:RESistance:IC?

// Querying the IF path resistance value
MODule:CTR:RESistance:IF?

// Querying the measurement delay time in pulse mode
MODule:CTR:PULSe:DELay?

// Setting the measurement delay time in pulse mode: 1=0us, 2=50us, 3=100us, 4=150us, 5=200us, 6=250us, 7=750us
MODule:CTR:PULSe:DELay {1|2|3|4|5|6|7}

// Saving user settings
MODule:SAVE

// Querying module basic information
*IDN?

// Saving calibration values
*Only applicable in NORMAL MODE
MODule:CALibration:SAVE

// Loading default values or factory calibration values
*Only applicable in NORMAL MODE
MODule:CALibration:RESTore {DEF|FACT}

// Starting or stopping the calibration process
*Only applicable in NORMAL MODE
MODule:CALibration:STATe {ON|OFF}

// Querying if the calibration process is ready
*Only applicable in NORMAL MODE
MODule:CALibration:READY?

// Setting the calibration item
*Only applicable in NORMAL MODE
MODule:CALibration:PROCess {VREF | NULL | RIF | RIC | VIF(DAC) | VCE | VC | VF},{1|10|100}

// Querying the calibration item
*Only applicable in NORMAL MODE
MODule:CALibration:PROCess?

// Executing the calibration process
*Only applicable in NORMAL MODE
MODule:CALibration:STEP {1|2|3|4|5|6|7|8},{value}

// Writing measurement values
*Only applicable in NORMAL MODE
MODule:CALibration:VALue {value}

// Reading a new set of measurement data (CTR), equivalent to INIT+FETC?
*Only applicable in NORMAL MODE
READ?

// Reading a new set of measurement data with 11 values (CTR/deltaCTR/IC/IF/VCE/VF/IC-RES/IF-RES/DATA-X axis/DATA-Y axis/deltaRd)
*Only applicable in NORMAL MODE
READ:ALL?

// Initiating a measurement
*Only applicable in NORMAL MODE
INITiate

// Reading a set of measurement data (used in conjunction with INIT)
*Only applicable in NORMAL MODE
FETCh?

// Querying J2200 error code
SYSTem:ERRor?

// Querying J2200 state: Returns values 1=OVLD, 16=OPEN, 64=UNDPSU, 128=Startup graph
MODule:CTR:STATe?

// Selecting the graph function: 1=VCE vs IC, 2=IF vs CTR, 3=VF vs IF
MODule:CTR:CURVe {1|2|3}

// Querying the graph function, returns format as VCE vs IC | IF vs CTR | VF vs IF
MODule:CTR:CURVe?

// Setting the number of curves for the graph
MODule:CTR:CURVe:STEP {value|MIN|MAX|DEF}

// Querying the number of curves for the graph
MODule:CTR:CURVe:STEP? {MIN|MAX|DEF}

// Setting the number of points per curve for the graph
MODule:CTR:CURVe:POINt {value|MIN|MAX|DEF}

// Querying the number of points per curve for the graph
MODule:CTR:CURVe:POINt? {MIN|MAX|DEF}

// Setting the VCE range for the graph function, parameters are PARA1 (low limit), PARA2 (up limit)
MODule:CTR:CURVe:VCE {value|MIN|MAX|DEF},{value|MIN|MAX|DEF}

```
// Querying the VCE range for the graph function
MODule:CTR:CURVe:VCE? {MIN|MAX|DEF}

// Setting the IF range for the graph function, parameters are PARA1 (low
limit), PARA2 (up limit)
MODule:CTR:CURVe:IF {value|MIN|MAX|DEF},{value|MIN|MAX|DEF}

// Querying the IF range for the graph function
MODule:CTR:CURVe:IF? {MIN|MAX|DEF}

// Setting the trend of the graph
MODuleCTR:CURVe:TRENd {LINear|LOG}

// Querying the trend of the graph
MODule:CTR:CURVe:TRENd?

// Starting the graph function
MODule:CTR:CURVe:STARt

// Reading data after starting the graph function
MODule:CTR:CURVe:READ?

// Remote graphing procedure
STEP1. MOD:CTR:MODE CURV
STEP2. MOD:CTR:CURV:STAR
STEP3. Keep querying MOD:CTR:CURV:READ? until the returned value is 0

// Internal command to unlock and set the acceptable serial number format
SYSTem:IDNStr:FILT 250115,"Serial Number Format"

// Internal command to input the serial number
SYSTem:IDNStr "Company Name,Module Name,Serial Number"

// Internal command to save the factory calibration values
 *Only applicable in NORMAL MODE
MODule:CALibration:SAVE:BAK
```

7 Specifications

1. Output Rating – Continue I$_F$ Mode

Item	Value
VCE[1]	15V (max)
I$_F$ (@1mA)	50µA ~ 1.2mA
I$_F$ (@10mA)	0.5mA ~ 12mA

2. Output Rating - Pulse I$_F$ Mode

Item	Value
VCE	15V (max)
I$_F$ (@1mA)	50µA ~ 1.2mA
I$_F$ (@10mA)	0.5mA ~ 12mA
I$_F$[2] (@100mA)	5mA ~ 60mA

3. Output Rating - Ic

Item	Value
Ic (@1mA)	2.4mA (max)
Ic (@10mA)	24mA (max)
Ic[2] (@100mA)	72mA (max)

4. OSC Port

Item	Value
Input Impedance	50ohm
Bandwidth	>100kHz
Maximum Input Power	+18dBm
I$_F$ Modulation Gain @ 1mA Range	0.45mA/V
I$_F$ Modulation Gain @ 10mA Range	4.5mA/V
I$_F$ Modulation Gain @ 100mA Range	45mA/V

5. CH1, CH2

Item	Value
Output Impedance[3]	50ohm
Bandwidth	>100kHz

6. Programming Accuracy (Setting + Range)

Item	%
VCE	1%+50mV
I$_F$	0.5%+0.5%

7. Read-Back Accuracy (Reading + Range)

Item	%
VCE	1%+50mV
V$_F$	1%+50mV
Ic	0.5%+0.5%
I$_F$	0.5%+0.5%

---

[1] The VCE value depends on the electrical characteristics of the DUT. It cannot be fixed via the instrument settings.
[2] For Pulsed Mode only.
[3] For optimal measurement accuracy, it is recommended to set the input impedance of the FRA input terminal to 1Mohm.

8. Read-Back Accuracy (Typical)

Item	Value
CTR	2%
△CTR	5%
△Rd	10%

9. General Specifications

Item	Description
Input Power Supply	5V/1A, 5VA, USB Type-C
Operating Temp.	20℃ ~ 40℃
Storage Temp.	-30℃ ~ 70℃
Size/Weight	123(L)x89(W)x55(H) mm/237g
Certificate	CE Compliant
Warranty	1-Year

* Note: The above specifications are subject to change without notice.