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TUV Rheinland of North America

TEST REPORT

EN 60825-1

Safety of laser products

Part 1: Equipment classification, requirements and user's guide

Section Two - Manufacturing requirements

Report Reference No. ..... :	30582901.01
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Date of issue ..... :	02/24/06

Testing Laboratory ..... :	TUV Rheinland Of North America inc
Address ..... :	12 Commerce Road, Newtown, CT. 06470USA
Testing location/procedure ..... :	CBTL ☒ SMT ☐ TMP ☐
Address ..... :	As above

Applicant's name ..... :	Arima Optoelectronic Corporation
Address ..... :	7F, No.349, Sec. 2, Renhe Rd., Dashi, Taoyuan 335, Taiwan (R.O.C.)

Test specification

Standard ..... :	IEC 60825-1:1993 + A1:2002 + A2:2001
Test procedure ..... :	Bauart
Non-standard test method ..... :	N/A

Test Report Form No. ..... :	EN 60825_1C / 02-02
TRF originator . ..... :	SEMKO
Master TRF ..... :	Dated 2002-02

Test item description	..... :	Laser Module
Trademark	..... :	Arima OPTOELECTRONICS CORPORATION
Model and/or type reference	..... :	APCD-650-xx-s
Rating(s)	..... :	3VDC; Laser Class 2

Test item particulars	
Equipment mobility ..... :	for building-in
Insulation Class of equipment ..... :	Class III
Mass of equipment (kg) ..... :	< < 1kg
Classification of the laser product	
Laser and/or LED product class for which the equipment is assigned ..... :	2
Laser and/or LED product class of the equipment ..... :	2
Laser and/or LED product class of the embedded laser/LED	3B
Test case verdicts	
Test case does not apply to the test object .... :	N/A
Test item does meet the requirement ..... :	P(ass)
Test item does not meet the requirement ..... :	F(ail)
Testing	
Date of receipt of test item ..... :	Dec 2005
Date(s) of performance of test ..... :	Jan 2006

General remarks:

This report shall not be reproduced except in full without the written approval of the testing laboratory.

The test results presented in this report relate only to the item(s) tested.

Clause numbers between brackets refer to clauses in EN 60825-1.

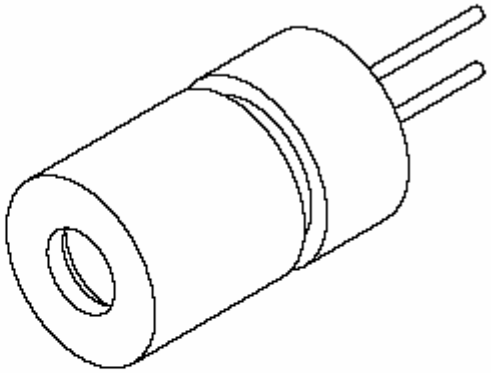
"(see remark #)" refers to a remark appended to the report.

"(see Annex #)" refers to an annex appended to the report.

Throughout this report a comma is used as the decimal separator.

General product information:

Φ6.3mm 650nm Laser Module

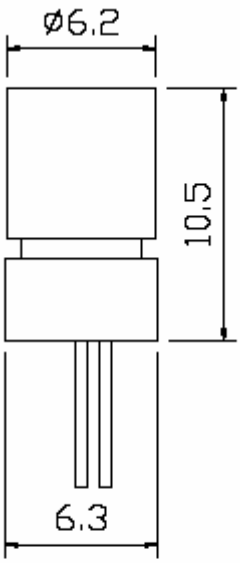


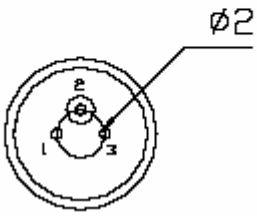
- **Features**

1. APC (auto power control) IC inside
2. Low current consumption of the APC circuit
3. Surge current protection
4. Include Optical Lens for laser pointer

- **Applications**

1. Laser pointers





- **Absolute maximum ratings**

Item	Symbol	Rating	Unit
Power supply voltage	V_{cc}	3	V
Laser Module optical output power	P_o	<1mW	mW
Operation temperature	T_{opr}	0~40	°C
Storage temperature	T_{stg}	0~60	°C

- **Electrical and optical characteristics (T_c=25 °C)**

Item	Symbol		Min.	Typ.	Max	Unit	Condition
Wavelength	λ		650	655	660	nm	P_o=<1mW
Output power	mW	C2		0.6	0.9		
		C3		2.5	3.0		
Operation current	I_{op}		-	15	20	mA	P_o=0.9mW V_{cc}=3V
Operation voltage	V_{op}		2.5	-	3	Volt	
Laser Beam spot size at 5m	<10mm						
Divergence angle	2.0 mrad						
Mean time to failure (MTTF) 3mW 25°C	>10000 hrs						

Copy of the Marking Plate and Warning Labels:

Since the component is for a built-in application and it does not constitute a removable laser system, no labels for compliance with Par. 5 are required.

4	**ENGINEERING SPECIFICATIONS**		P
4.1	General remarks		P
4.1.1	Modification	No modification	N.A.
4.2	Protective housing		N.A.
4.2.1	General		P
4.2.2	Service		N.A.
4.2.3	Removable laser system	Not a removable laser system not removable	N.A.
4.3	Access panels and safety interlocks		N.A.
4.3.1	Access panels of protective housing	Built-in component	N.A.
	Product Class .....:		—
	Accessible emission during removal of access panel .....:		N.A.
	Access panel/s intended to be removed during maintenance or operation		N.A.
	Removal of the panel/s gives access to laser radiation levels designated by “X” in the table		N.A.
	Accessible emissions after removal .....:		—
4.3.2	Deliberate override mechanism	No deliberate override mechanism	N.A.
4.4	Remote interlock connector	No remote interlock connector	N.A.
4.5	Key control	No key control	N.A.
4.6	Laser radiation emission warning		N.A.
4.6.1	Audible or visible warning		N.A.
4.6.2	Operational control and laser aperture		N.A.
4.6.3	Laser emission distributed through more than one output		N.A.
4.7	Beam stop or attenuation		N.A.
4.8	Controls		N.A.
4.9	Viewing optics		N.A.
	a) human access to laser radiation in excess of Class 1M prevented when the shutter is opened or attenuation varied		N.A.
	b) opening of the shutter or variation of the attenuation prevented when exposure to laser radiation in excess of Class 1M is possible		N.A.
4.10	Scanning safeguard		N.A.
4.11	Alignment aids		N.A.

4.12	Walk-in access		N.A.
	a). Means provided so that any person inside the housing can prevent activation of a Class 3B or 4 laser hazard	No walk-in access	N.A.
	b). A warning device providing adequate warning of emission to any person within the housing	No walk-in access	N.A.
4.13	Environmental conditions		P
	- climatic conditions		P
	- vibration and shock		P
4.14	Protection against other hazards		P
4.14.1	Non-optical hazards		P
	- electrical hazards;	Refer to IEC 60950-1 test report	P
	- excessive temperature;	Refer to IEC 60950-1 test report	P
	- spread of fire from the equipment;	Refer to IEC 60950-1 test report	P
	- sound and ultrasonic;		N.A.
	- harmful substances;		N.A.
	- explosion;	No risk of explosion	N.A.
4.14.2	Collateral radiation	No collateral radiation	N.A.

5	**LABELLING**		P
5.1	General	Built in component; labels, where required, are to be implemented in the end-use application	N.A.
	LASER PRODUCT CLASS .....:	Class 2	P
5.2	Class 1 explanatory label provided on the product		N.A.
	Optional: Class 1 explanatory label provided in the user manual		N.A.
	Class 1M explanatory label provided on the product		N.A.
	Optional: Class 1M explanatory label provided in the user manual		N.A.
5.3	Class 2 explanatory and warning label		N.A.
	Class 2M explanatory and warning label		N.A.
5.4	Class 3R explanatory and warning label		N.A.
5.5	Class 3B explanatory and warning label		N.A.
5.6	Class 4 explanatory and warning label		N.A.
5.7	Aperture label .....:		N.A.

5.8	Radiation output and standards information		N.A.
	Maximum output of laser radiation .....:		—
	Pulse duration .....:		—
	Emitted wavelength(s) .....:		N.A.
	The name and publication date of the standard .:		N.A.
5.9	Labels for access panels		N.A.
	RADIATION CLASS.....:		
5.9.1	Labels for panels		N.A.
	Warning used.....:	Built-in component	—
5.9.2	Labels for safety interlocked panels		N.A.
	Warning used.....:	Safety interlocks not present or required	—
5.10	Warning for invisible laser radiation .....:		N.A.
5.11	Warning for visible laser radiation .....:		N.A.
5.12	Warning for LED radiation .....:		N.A.

6	**OTHER INFORMATIONAL REQUIREMENTS**		P
6.1	Information for the user	The required information to be provided in the end-use application	N.A.
	a) adequate instructions for proper assembly, maintenance and safe use		N.A.
	b) warning for Class 1M and 2M		N.A.
	c) laser beam parameters		N.A.
	d) reproduction of labels		N.A.
	e) location of laser apertures		N.A.
	f) listing of controls, adjustment of procedures and warning statement		N.A.
	g) information about laser energy source if not incorporated in the manual		N.A.
6.2	Purchasing and service information	The required information to be provided in the end-use application	N.A.
	a). Safety classification of each laser product stated in descriptive material		N.A.
	b). Adequate instructions for servicing available		N.A.

7	**ADDITIONAL REQUIREMENTS FOR SPECIFIC LASER PRODUCTS**	

7.1	Medical laser products	Not a medical device	N.A.
	Class 3B and Class 4 medical laser products comply with EN 60601-2-22		N.A.
	Medical laser products provided with instructions for calibration of measurement system		N.A.
7.2	Applicable other parts of the standard series IEC/EN 60825		P
	IEC 60825-2 (OFCSs)		N.A.
	IEC 60825-4 (laser guards)		N.A.
	IEC/TR 60825-3 (laser shows)		N.A.
	IEC/TR 60825-5 (manufacturer's checklist)		P
	IEC/TS 60825-6 (visible information transmission)		N.A.
	IEC/TS 60825-7 (non-visible information transmission)		N.A.
	IEC/TR 60825-8 (medical laser equipment)		N.A.
	IEC/TR 60825-9 (review of MPEs for incoherent radiation)		N.A.
8	**CLASSIFICATION**		
8.2	Description of laser classes		P
8.3	Classification responsibilities		P
8.4	Classification rules		P
8.4a	Radiation of a single wavelength	Within the wavelength range: 650 nm – 660 nm	P
8.4b	Radiation of multiple wavelengths		N.A.
	1). Laser product emission two or more wavelengths in spectral regions shown as additive in Table 5.....:		N.A.
	2). Laser product emission two or more wavelengths in spectral regions not shown as additive in Table 5.....:		N.A.
8.4c	Radiation from extended sources		N.A.
	Value of angular subtence α (mrad).....:		—
8.4d	Non-circular and multiple sources		P
8.4e	Time basis		P
	i) 0.25s	Laser Class 2	P
	ii) 100s		N.A.
	iii) 30000s		N.A.

8.4f	Repetitively pulsed or modulated lasers	CW emissions	N.A.
	i) exposure from a single pulse not exceeding the AEL for a single pulse		N.A.
	ii) average power for a pulse train		N.A.
	iii) the average pulse energy from pulses within a pulse train not exceeding the AEL for a single pulse multiplied by the correction factor C_5		N.A.
	AEL for continued operation used….....:		N.A.
	Total-on-time-pulse (TOTP) method used…….....:		N.A.

9	**MEASUREMENTS FOR CLASSIFICATION (Normal operating condition)**		**P**
9.1	Tests		P
9.2	Measurement conditions		P
	Measured laser radiation ..... :	See the attachment	—
9.3	Measurement geometry		P
	a) aperture diameter (mm)..... :	50 mm	P
	b) measurement distance (mm)..... :	2000 mm	P
	c) angle of acceptance γ ..... :		P
	i) photochemical limits…..... :		N.A.
	ii) all other limits ..... :	100 mrad	P

Appended table	**EQUIPMENT MANUFACTURE INFORMATION (DATA SHEET) ABOUT THE CONTAINING LASER COMPONENT/S**		**P**
	Manufacturer ..... :	Arima Optoelectronics	P
	Type designation ..... :	-	P
	Structure ..... :	Laser diode	—
	Wavelength ..... :	650-660 nm	P
	Output power (min. and max.) ..... :	See the measurement results	P
	Radiation is		P
	Continuous..... :		P
	Pulsed ..... :		N.A.
	Pulse time ..... :		N.A.
	Pulse repetition frequency ..... :		N.A.
	Others ..... :		—

	LEDs		**N.A.**
	Manufacturer..... :		-
	Type designation ..... :		-
	Wavelength ..... :		-
	Others ..... :		-

	PIC UP UNIT		**N.A.**
	Manufacturer ..... :		-

	Type designation .....:		-
	Others .....:		-

	MEASUREMENT EQUIPMENT		**P**
	Type of equipment.....:	1) power meter 2) detector	—
	Manufacturer .....:	Newport	—
	Type designation .....:	1) 1835-C 2) 818-SL	—
	Others .....:		—

The measurements were completed under normal and single fault conditions.

Listed below are measurement results under normal operating condition:

Supply voltage V]	Radiant power [µW]
3.0	311
3.3	318

The laser module incorporates an ASIC (Application Specific Integrated Circuit).

Listed below are measurement results corresponding to the fault of components, which are located externally to the ASIC:

Failure condition	Radiant Power [µW]
Open feedback	No emissions
Short circuit of R1	749
Short circuit of R2	754

In order to validate failures of components inside of the ASIC, an equivalent circuit was built reflecting short circuit of the bipolar transistor Q8(C,E).

After an application of 2.1 VDC to the equivalent circuit, the laser diode started to lase. These initial radiant power values were as follows:

Sample number	Forward current [mA]	Radiant Power [µW]
1	20	931
2	22	874
3	23	840
4	22	930

Application of the nominal supply voltage of 3.0 V leads to the following results:

Sample number	Forward current [A]	Radiant Power [µW]
1	3	29
2	3	35

3	3	39
4	3	1 (damaged)

A short circuit of the R1 in the equivalent ASIC circuit leads to the damage of the laser diode (no emissions).

The analysis of the optical system for the laser module supports the assumption that the angle of subtense is less than 1.5 mrad. The parameter C6 is equal 1 then.

The AEL value for the Laser Class 2: 1 mW.

Conclusion: The radiant emissions from the laser diode is less than AEL for the Laser Class 2 under normal and reasonably foreseeable single fault condition.