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# **LCD Module**

## **Product Specification**

**Product: DT028ATFT & DT028ATFT-TS**  
**2.8" TFT Display Module (240RGBx320DOTS)**

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**3 November 2011.**

**1. REVISION RECORD**

<b>VERSION</b>	<b>CHANGES</b>	<b>DATE</b>
1.0	Initial revision	26 April 2011
2.0	Added details of TS version in pages 3, 5, 7, & 8	9 June 2011
2.1	Changed the temperature range of TS version	3 November 2011

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## 2. Introduction

**DT028ATFT** and **DT028ATFT-TS** is a display module that contains a TFT display with a 320 \* 240 RGB resolution. The driver used for this project is the Ilitek **ILI9341** or **compatible** and can display 262K colors. The driver is mounted on the glass and the interconnection via FPC including components to drive the display module.

## 3. General Specifications

Item	Specification	Unit
LCD mode	Transmissive	---
Resolution	240(RGB)	Line
	320	Line
Diagonal Size	2.8	Inch
Overall Size	50.00	mm
	69.20	mm
Active area	43.20	mm
	57.60	mm
Optimum Viewing Direction	6 o'clock	---
Driver IC	ILI9341	---
Interface type	MCU parallel / RGB (1)	---
Colours	262K	---
Operation temperature range	-20~70	°C
Storage temperature range	-30~80	°C

### Remarks:

- (1) Serial interface is available, but not recommendable, as the speed of it is very slow.
- (2) Recommended mating connector: Hirose FH19SC-45S-0.5SH, FH12S-45S-0.5SH; or Molex 0512964593, 0512964594; or equivalent
- (3) Color tune may be changed slightly by temperature and driving voltage.
- (4) RoHS compliant.

### Component Life Cycle

- 1) Storage Life: min. 1 Year
- 2) Operation Life (\*1): min. 43 x 10<sup>3</sup> h (24hr/day x 7days/week x 52weeks/year x 5years)  
(Not include backlight)
- 3) Storage and Operation Life Times are defined for a temperature of +25°C

### Notes:

\*1. Operation life ends when one of the listed faults occurs:

- The on/off response-times reach 1.5 times of the max. value specified for a new display
- The contrast is reduced to 0.5 of the original contrast value
- Loss of function
- The number of cosmetic defects exceeds the maximum defined

### 4. Mechanical Drawing

#### • DT028ATFT

REV.	DESCRIPTIONS	DWN.	APPD.	DATE
		No. PIN NAME	No. PIN NAME	
		1 LED A	24 DB8	
		2 LED K1	25 DB7	
		3 LED K2	26 DB6	
		4 LED K3	27 DB5	
		5 LED K4	28 DB4	
		6 IM0	29 DB3	
		7 IM1	30 DB2	
		8 IM2	31 DB1	
		9 IM3	32 DB0	
		10 FMARK	33 CS	
		11 VSYNC	34 WR	
		12 HSYNC	35 RS/SCL	
		13 DOTCLK	36 RD	
		14 ENABLE	37 RESET	
		15 DB17	38 SDO	
		16 DB16	39 SDI	
		17 DB15	40 VCC	
		18 DB14	41 GND	
		19 DB13	42 YD(NC)	
		20 DB12	43 XR(NC)	
		21 DB11	44 YU(NC)	
		22 DB10	45 XL(NC)	
		23 DB9		

Bending For Reference

DOTS DETAIL

CIRCUIT DIAGRAM

CONSTANT CURRENT: I=4\*20=80mA Vf=3.2±0.3V

**NOTES:**

1. DISPLAY TYPE: TFT-LCD
2. VIEWING DIRECTION: 6:00
3. MAIN LCD DRIVE IC: ILI9341
4. POLARIZER MODE: TRANSMISSIVE/ POSITIVE
5. DRIVE METHOD: 1/320 DUTY
6. VCC: 2.8V (Typ)
7. BACKLIGHT: WHITE LED-3CHIP
8. OPERATING TEMP: -20°C ~ 70°C
9. STORAGE TEMP: -30°C ~ 80°C
10. UNMARKED TOLERANCE: ±0.2
11. IMPORTANT DIMENSION: ( )
12. REFERENCE DIMENSION: ( )
13. REQUIREMENTS ON ENVIRONMENTAL PROTECTION: RoHS

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SCALE	DRAWN BY	DATE
	APP. BY	DATE
DWG. DT028ATFT ASSY		
PROJ.#	DWG.#	
MODEL#	REV.	DATE
RELEASE TO:	GIB	

DO NOT SCALE DRAWING

### • DT028ATFT-TS

	REV	DESCRIPTIONS	D	DRAWN	APPRD.	DATE

No.	PIN NAME	No.	PIN NAME
1	LED A	24	DB8
2	LED K1	25	DB7
3	LED K2	26	DB6
4	LED K3	27	DB5
5	LED K4	28	DB4
6	IM0	29	DB3
7	IM1	30	DB2
8	IM2	31	DB1
9	IM3	32	DB0
10	FMARK	33	CS
11	VSYNC	34	WR
12	HSYNC	35	RS/SCL
13	DOTCLK	36	RD
14	ENABLE	37	RSEFT
15	DB17	38	S00
16	DB16	39	SDI
17	DB15	40	VCC
18	DB14	41	GND
19	DB13	42	YD
20	DB12	43	XR
21	DB11	44	YU
22	DB10	45	XL
23	DB9		

Bending For Reference

CIRCUIT DIAGRAM

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SCALE	DRAWN BY	DATE	18MAY11
SHT.#	APP. BY	DATE	
DWG. DT028ATFT-TS ASSY			
PROJ.#	MODEL#	DWG#	
REV. 01		REV. 01	DATE

DO NOT SCALE DRAWING

5. Interface Description

Pin no	Symbol	I/O	Description																																																																																													
1	LED A	---	Backlight anode.																																																																																													
2	LED K1	---	Backlight cathode K1																																																																																													
3	LED K2	---	Backlight cathode K2																																																																																													
4	LED K3	---	Backlight cathode K3																																																																																													
5	LED K4	---	Backlight cathode K4																																																																																													
6	IM0	I	- Select the MCU interface mode																																																																																													
			<table border="1"> <thead> <tr> <th rowspan="2">IM3</th> <th rowspan="2">IM2</th> <th rowspan="2">IM1</th> <th rowspan="2">IM0</th> <th rowspan="2">MCU-Interface Mode</th> <th colspan="2">DB Pin in use</th> </tr> <tr> <th>Register/Content</th> <th>GRAM</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>80 MCU 8-bit bus interface I</td> <td>D[7:0]</td> <td>D[7:0]</td> </tr> <tr> <td>0</td> <td>0</td> <td>0</td> <td>1</td> <td>80 MCU 16-bit bus interface I</td> <td>D[7:0]</td> <td>D[15:0]</td> </tr> <tr> <td>0</td> <td>0</td> <td>1</td> <td>0</td> <td>80 MCU 9-bit bus interface I</td> <td>D[7:0]</td> <td>D[8:0]</td> </tr> <tr> <td>0</td> <td>0</td> <td>1</td> <td>1</td> <td>80 MCU 18-bit bus interface I</td> <td>D[7:0]</td> <td>D[17:0]</td> </tr> <tr> <td>0</td> <td>1</td> <td>0</td> <td>1</td> <td>3-wire 9-bit data serial interface I</td> <td colspan="2">SDA: In/OUT</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> <td>0</td> <td>4-wire 8-bit data serial interface I</td> <td colspan="2">SDA: In/OUT</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> <td>0</td> <td>80 MCU 16-bit bus interface II</td> <td>D[8:1]</td> <td>D[17:10], D[8:1]</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> <td>1</td> <td>80 MCU 8-bit bus interface II</td> <td>D[17:10]</td> <td>D[17:10]</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td>0</td> <td>80 MCU 18-bit bus interface II</td> <td>D[8:1]</td> <td>D[17:0]</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td>1</td> <td>80 MCU 9-bit bus interface II</td> <td>D[17:10]</td> <td>D[17:9]</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td>1</td> <td>3-wire 9-bit data serial interface II</td> <td colspan="2">SDI: In SDO: Out</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>0</td> <td>4-wire 8-bit data serial interface II</td> <td colspan="2">SDI: In SDO: Out</td> </tr> </tbody> </table>	IM3	IM2	IM1	IM0	MCU-Interface Mode	DB Pin in use		Register/Content	GRAM	0	0	0	0	80 MCU 8-bit bus interface I	D[7:0]	D[7:0]	0	0	0	1	80 MCU 16-bit bus interface I	D[7:0]	D[15:0]	0	0	1	0	80 MCU 9-bit bus interface I	D[7:0]	D[8:0]	0	0	1	1	80 MCU 18-bit bus interface I	D[7:0]	D[17:0]	0	1	0	1	3-wire 9-bit data serial interface I	SDA: In/OUT		0	1	1	0	4-wire 8-bit data serial interface I	SDA: In/OUT		1	0	0	0	80 MCU 16-bit bus interface II	D[8:1]	D[17:10], D[8:1]	1	0	0	1	80 MCU 8-bit bus interface II	D[17:10]	D[17:10]	1	0	1	0	80 MCU 18-bit bus interface II	D[8:1]	D[17:0]	1	0	1	1	80 MCU 9-bit bus interface II	D[17:10]	D[17:9]	1	1	0	1	3-wire 9-bit data serial interface II	SDI: In SDO: Out		1	1	1	0	4-wire 8-bit data serial interface II	SDI: In SDO: Out	
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			MPU Parallel interface bus and serial interface select																																																																																													
			If use RGB Interface must select serial interface.																																																																																													
			* : Fix this pin at VDDI or VSS.																																																																																													
10	FMARK	O	Tearing effect output pin to synchronize MPU to frame writing, activated by S/W command. When this pin is not activated, this pin is low. If not used, open this pin.																																																																																													
11	VSYNC	I	Frame synchronizing signal for RGB interface operation. <i>Fix to VDDI or VSS level when not in use.</i>																																																																																													
12	HSYNC	I	Line synchronizing signal for RGB interface operation. <i>Fix to VDDI or VSS level when not in use.</i>																																																																																													
13	DOTCLK	I	Dot clock signal for RGB interface operation. <i>Fix to VDDI or VSS level when not in use.</i>																																																																																													
14	ENABLE	I	Data enable signal for RGB interface operation. <i>Fix to VDDI or VSS level when not in use.</i>																																																																																													
15~32	DB17~DB0	I/O	18-bit parallel bi-directional data bus for MCU system and RGB interface mode <i>Fix to VSS level when not in use.</i> Please refer to the IM[0:3] setting.																																																																																													
33	CS	I	Chip select input pin (“Low” enable). This pin can be permanently fixed “Low” in MPU interface mode only.																																																																																													
34	WR	I	- 8080-I / 8080-II system (WRX): Serves as a write signal and writes data at the rising edge. - 4-line system (D/CX): Serves as command or parameter select. <i>Fix to VDDI or VSS level when not in use.</i>																																																																																													

Pin no	Symbol	I/O	Description
35	RS/SCL	I	This pin is used to select "Data or Command" in the parallel interface or 4-wire 8-bit serial data interface. When RS = '1', data is selected. When RS = '0', command is selected. This pin is used serial interface clock in 3-wire 9-bit / 4-wire 8-bit serial data interface. If not used, this pin should be connected to VDDI or VSS.
36	RD	I	8080-I / 8080-II system (RDX): Serves as a read signal and MCU read data at the rising edge. <i>Fix to VDDI or VSS level when not in use.</i>
37	RESET	I	Reset pin.
38	SDO	O	Serial output signal. The data is outputted on the falling edge of the SCL signal. If not used, open this pin
39	SDI	I	When IM[3] : Low, Serial in/out signal. When IM[3] : High, Serial input signal. The data is applied on the rising edge of the SCL signal. If not used, fix this pin at VDDI or VSS.
40	VCC	---	Power supply 2.8V
41	GND	---	Power ground 0V
42	NC / YD	---	No connection (DT028ATFT) / YD of touch screen (DT028ATFT-TS)
43	NC / XR	---	No connection (DT028ATFT) / XR of touch screen (DT028ATFT-TS)
44	NC / YU	---	No connection (DT028ATFT) / YU of touch screen (DT028ATFT-TS)
45	NC / XL	---	No connection (DT028ATFT) / XL of touch screen (DT028ATFT-TS)



## 6. Absolute Maximum Ratings

(Ta=25°C)

Item	Symbol	Min.	Max.	Unit
Power supply voltage	VCC	-0.3	+ 4.6	V
Logic signal input/output voltage	Vcc	-0.3	+ 4.6	V
Operating Temperature	TOP	-20	+70	°C
Storage Temperature	TST	-30	+80	°C

Note:

- When temperature is below 0°C, the response time of liquid crystal (LC) will be slower and the color of panel will be darker.
- If module driving condition exceeds the absolute maximum ratings, permanent damaged may be resulted. If module is driven within the absolute maximum ratings but exceeded the DC characteristics, mal-function may be resulted.
- VDD/VCC > VSS

## 7. Electrical Characteristics

DC Characteristics

(Vss=0V, Ta=25°C)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Power supply	VCC / VDD		2.5	2.8	3.3	V
Input voltage "H"	VIH	---	0.7 VCC	---	VCC	V
Input voltage "L"	VIL	---	VSS	---	0.3 VCC	V
Output voltage "H"	VOH	IOL=-1.0mA	0.8 VCC	---	VCC	V
Output voltage "L"	VOL	IOL=1.0mA	VSS	---	0.2 VCC	V

## 8. Display Controller /Power Supply Timing

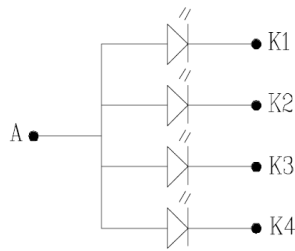
See Display Controller Specification: Ilitek ILI9341

### 9. Backlight specification

(Vcc=2.8V, Vss=0V, Ta=25°C)

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Supply voltage	Vf	If=80mA	2.9	3.2	3.5	V	1
Forward current	If		---	---	80	mA	2
Uniformity	ΔBp	If=80mA	80	---	---	%	
Color coordination	X		0.270	---	0.315	---	
	Y		0.270	---	0.315	---	

LED circuit diagram:



CIRCUIT DIAGRAM

Constant current If=4x20mA=80mA; Vf=3.2V(typ)

Note:

- 1) The LED's driver mode needs to be constant current mode.
- 2) Permanent damage to the device may occur if maximum values are exceeded. Functional operation should be restricted to the conditions described under normal operating conditions.

### 10. Optical Characteristics

(Vcc=2.8V, Vss=0V, Ta=25°C)

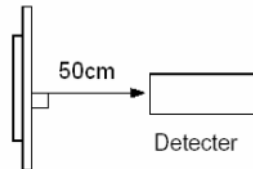
Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Brightness	Bp	θ=0°	180	220	---	cd/m <sup>2</sup>	1
Uniformity	ΔBp	Φ=0°	80	---	---	%	1, 2
Viewing Angle	θ1 (Φ=90° or 270°)	Cr≥10	-70 ~ 50			deg	3
	θ2 (Φ=0° or 180°)		-70 ~ 70				
Contrast ratio	Cr	θ=0° Φ=0°	400	500	---	---	4
Response Time	Tr		---	25	30	ms	5
	Tf						
CIE (x,y) Chromaticity	White	x	0.230	0.280	0.330	---	1, 6
		y	0.248	0.298	0.348		
	Red	x	0.580	0.630	0.680		
		y	0.279	0.329	0.379		
	Green	x	0.288	0.338	0.388		
		y	0.557	0.607	0.657		
	Blue	x	0.093	0.143	0.193		
		y	0.025	0.075	0.125		
NTSC Ratio	S	---	65	---	%		

Note 1: The data are measured after LEDs are turned on for 5 minutes. LCM displays full white.  
The brightness is the average value of 9 measured spots. Measurement equipment PR-705 (Φ8mm)

Measuring condition:

- Measuring surroundings: Dark room.
- Measuring temperature: Ta=25°C.
- Adjust operating voltage to get optimum contrast at the center of the display.

Measured value at the center point of LCD panel after more than 5 minutes while backlight turning on.

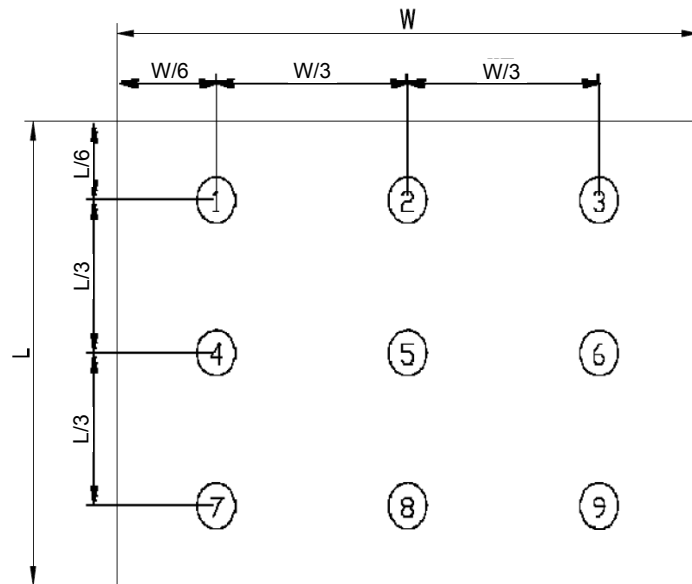


Note 2: The luminance uniformity is calculated by using following formula.

$$\Delta Bp = Bp (\text{Min.}) / Bp (\text{Max.}) \times 100 (\%)$$

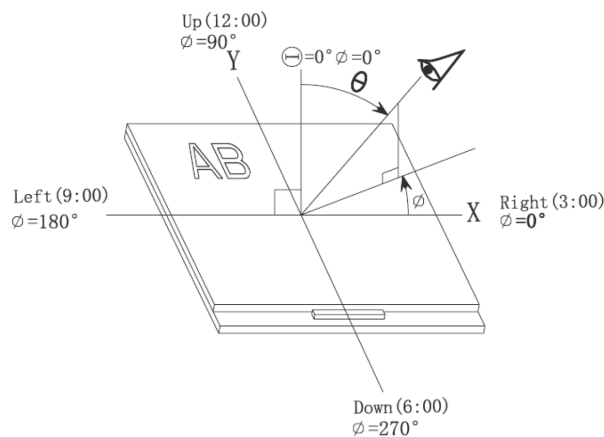
Bp (Max.) = Maximum brightness in 9 measured spots

Bp (Min.) = Minimum brightness in 9 measured spots.



Measurement equipment PR-705 (Φ8mm)

Note 3: The definition of viewing angle:  
Refer to the graph below marked by  $\theta$  and  $\Phi$



Note 4: The definition of contrast ratio (Test LCM using PR-705):

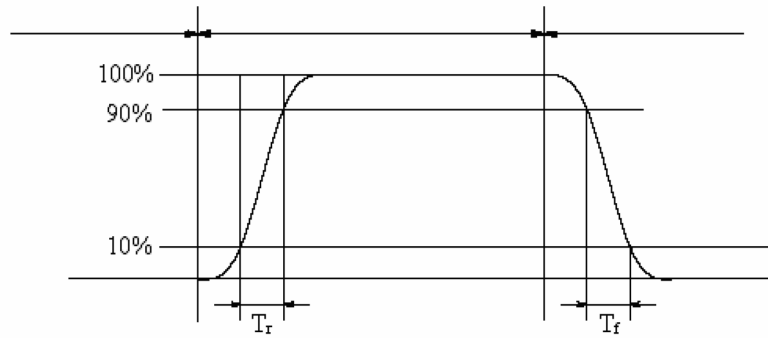
$$\text{Contrast Ratio (CR)} = \frac{\text{Luminance When LCD is at "White" state}}{\text{Luminance When LCD is at "Black" state}}$$

(Contrast Ratio is measured in optimum common electrode voltage)

Note 5: Definition of Response time. (Test LCD using DMS501):

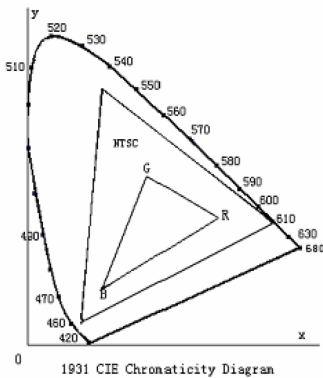
The output signals of photo detector are measured when the input signals are changed from "black" to "white" (falling time) and from "white" to "black" (rising time), respectively.

The response time is defined as the time interval between the 10% and 90% of amplitudes. Refer to figure as below.



The definition of response time

Note 6: Definition of Color of CIE Coordinate and NTSC Ratio.



Color gamut:

$$S = \frac{\text{area of RGB triangle}}{\text{area of NTSC triangle}} \times 100\%$$

## 11. Safety Precaution

### Handling precautions:

- This device is susceptible to Electro-Static Discharge (ESD) damage. Observe Anti-Static precautions.

### Power supply precautions:

- Identify and, at all times, observe absolute maximum ratings for both logic and LC drivers. Note that there is some variance between models.
- Prevent the application of reverse polarity to VCC and GND, however briefly.
- Use a clean power source free from transients. Power up conditions are occasionally “jolting” and may exceed the maximum ratings of the modules.
- The VCC power of the module should also supply the power to all devices that may access the display. Don't allow the data bus to be driven when the logic supply to the module is turned off.

### Operating precautions:

- DO NOT plug or unplug the module when the system is powered up.
- Minimize the cable length between the module and host MPU.
- Operate the module within the limits of the modules temperature specifications.

### Mechanical/Environmental precautions:

- Improper soldering is the major cause of module difficulty. Use of flux cleaner is not recommended as they may seep under the elastomeric connection and cause display failure.
- Mount the module so that it is free from torque and mechanical stress.
- Surface of the LCD panel should not be touched or scratched. The display front surface is an easily scratched, plastic polarizer. Avoid contact and clean only when necessary with soft, absorbent cotton dampened with petroleum benzene.
- Always employ anti-static procedure while handling the module.
- Prevent moisture build-up upon the module and observe the environmental constraints for storage temperature and humidity.
- Do not store in direct sunlight
- If leakage of the liquid crystal material should occur, avoid contact with this material, particularly ingestion. If the body or clothing becomes contaminated by the liquid crystal material, wash thoroughly with water and soap

Компания «Life Electronics» занимается поставками электронных компонентов импортного и отечественного производства от производителей и со складов крупных дистрибьюторов Европы, Америки и Азии.

С конца 2013 года компания активно расширяет линейку поставок компонентов по направлению коаксиальный кабель, кварцевые генераторы и конденсаторы (керамические, пленочные, электролитические), за счёт заключения дистрибьюторских договоров

Мы предлагаем:

- Конкурентоспособные цены и скидки постоянным клиентам.
- Специальные условия для постоянных клиентов.
- Подбор аналогов.
- Поставку компонентов в любых объемах, удовлетворяющих вашим потребностям.
- Приемлемые сроки поставки, возможна ускоренная поставка.
- Доставку товара в любую точку России и стран СНГ.
- Комплексную поставку.
- Работу по проектам и поставку образцов.
- Формирование склада под заказчика.
- Сертификаты соответствия на поставляемую продукцию (по желанию клиента).
- Тестирование поставляемой продукции.
- Поставку компонентов, требующих военную и космическую приемку.
- Входной контроль качества.
- Наличие сертификата ISO.

В составе нашей компании организован Конструкторский отдел, призванный помогать разработчикам, и инженерам.

Конструкторский отдел помогает осуществить:

- Регистрацию проекта у производителя компонентов.
- Техническую поддержку проекта.
- Защиту от снятия компонента с производства.
- Оценку стоимости проекта по компонентам.
- Изготовление тестовой платы монтаж и пусконаладочные работы.



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