



VFC32

Voltage-to-Frequency and Frequency-to-Voltage CONVERTER

FEATURES

- OPERATION UP TO 500kHz
- EXCELLENT LINEARITY ±0.01% max at 10kHz FS ±0.05% max at 100kHz FS
- V/F OR F/V CONVERSION
- MONOTONIC
- VOLTAGE OR CURRENT INPUT

APPLICATIONS

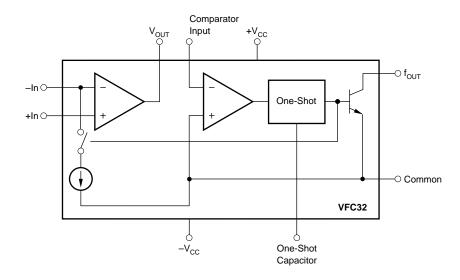
- INTEGRATING A/D CONVERTER
- SERIAL FREQUENCY OUTPUT
- ISOLATED DATA TRANSMISSION
- FM ANALOG SIGNAL MOD/DEMOD
- MOTOR SPEED CONTROL
- TACHOMETER

DESCRIPTION

The VFC32 voltage-to-frequency converter provides an output frequency accurately proportional to its input voltage. The digital open-collector frequency output is compatible with all common logic families. Its integrating input characteristics give the VFC32 excellent noise immunity and low nonlinearity.

Full-scale output frequency is determined by an external capacitor and resistor and can be scaled over a wide range. The VFC32 can also be configured as a frequency-to-voltage converter.

The VFC32 is available in 14-pin plastic DIP, SO-14 surface-mount, and metal TO-100 packages. Commercial, industrial, and military temperature range models are available.



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SPECIFICATIONS

At $T_A = +25$ °C and $V_{CC} = \pm 15$ V, unless otherwise noted.

		\ v	FC32KP, K	U		VFC32BM	I		VFC32SM	<u> </u>	
PARAMETER	CONDITIONS	MIN TYP MAX		MAX	MIN TYP MAX			MIN	UNITS		
INPUT (V/F CONVERTER)	$F_{OLIT} = V_{IN}/7.5 R_1 C_1$										
Voltage Range ⁽¹⁾	I										
Positive Input		>0		+0.25mA	*		*	*		*	V
				x R₁							
Negative Input		>0		-10	*		*	*		*	V
Current Range(1)		>0		+0.25	*		*	*		*	mA
Bias Current											
Inverting Input			20	100		*	*		*	*	nA
Noninverting Input			100	250		*	*		*	*	nA
Offset Voltage(2)			1	4		*	*		*	*	mV
Differential Impedance		300 10	650 10		*	*		*	*		kΩ pF
Common-mode											
Impedance		300 3	500 3		*	*		*	*		MΩ pF
INPUT (F/V CONVERTER)	V -75R C F										
Impedance	V _{OUT} = 7.5 K ₁ O ₁ I IN	50 10	150 10		*	*		*	*		kΩ pF
Logic "1"		30 10	+1.0		*	*	*	*	1	*	V V
Logic "0"			-0.05		*		*	*		*	V
Pulse-width Range		0.1	-0.03	150k/F _{MAX}	*		*	*		*	μs
-		0.1		130K/1 MAX	~		*	*		7	μο
ACCURACY	0.0411= + 0										1
Linearity Error ⁽³⁾	0.01Hz ≤ Oper			10.010(6)			.				0, , ====
	Freq ≤ 10kHz		±0.005	±0.010 ⁽⁴⁾		*	*		*	*	% of FSR ⁽⁵⁾
	0.1Hz ≤ Oper						.				0, , 50-
	Freq ≤ 100kHz		±0.025	±0.05		*	*		*	*	% of FSR
	0.5Hz ≤ Oper										
	Freq ≤ 500kHz		±0.05			*			*		% of FSR
Offset Error Input											
Offset Votlage ⁽²⁾			1	4		*	*		*	*	mV
Offset Drift ⁽⁶⁾			±3			*			*		ppm of FSR/°
Gain Error ⁽²⁾			5			*			*		% of FSR
Gain Drift ⁽⁶⁾	f = 10kHz		±75			±50	±100		±70	±150	ppm/°C
Full Scale Drift	f = 10kHz		±75			±50	±100		±70	±150	ppm of FSR/°
(offset drift and											
gain drift)(6, 7)											
Power Supply	$f = DC$, $\pm V_{CC} = 12VDC$										
Sensitivity	to 18VDC			±0.015			*			*	% of FSR/%
OUTPUT (V/F CONVERTE	R) (open collector output)										
Voltage, Logic "0"	I _{SINK} = 8mA	0	0.2	0.4	*	*	*	*	*	*	V
Leakage Current,	I SINK STILL	*	0.2	0	•			'			,
Logic "1"	V _o = 15V		0.01	1.0		*	*		*	*	μА
Voltage, Logic "1"	External Pull-up Resistor		0.0.								μ.,
ronago, zogio :	Required (see Figure 4)			V _{PU}			*			*	V
Pulse Width	For Best Linearity		0.25/F _{MAX}	* PU		*			*		s
Fall Time	$I_{OUT} = 5\text{mA}, C_{LOAD} = 500\text{pF}$		O.Z.O. MAX	400			*			*	ns
OUTPUT (F/V CONVERTE											1
Voltage	I _o ≤ 7mA	0 to +10			*			*			V
Current	V _o ≤ 7VDC	+10			*			*			mA
Impedance	Closed Loop			1			*			*	Ω
Capacitive Load	Without Oscillation			100		<u></u>	*	<u></u>	<u>L_</u>	*	pF
DYNAMIC RESPONSE											
Full Scale Frequency				500(8)	*			*			kHz
Dynamic Range		6			*			*			decades
Settling Time	(V/F) to Specified Linearity										1
=	for a Full Scale Input Step		(9)			*			*		1
Overload Recovery	< 50% Overload		(9)			*			*		1
POWER SUPPLY											
Rated Voltage			±15								V
Voltage Range		±11	-10	±20					*		V
Quiescent Current		-''	±5.5	±6.0		*	*		*		mA
						_ ^	*		^		IIIA
TEMPERATURE RANGE		_								,	
>: nogitiontion	I	0	I	+70	-25	I	+85	-55	[+125	°C
							40-	l		/	
Specification Operating Storage		-25 -25		+85 +85	–55 –65		+125 +150	-55 -65		+125 +150	°C °C

^{*} Specification the same as VFC32KP.

NOTES: (1) A 25% duty cycle (0.25mA input current) is recommended for best linearity. (2) Adjustable to zero. See Offset and Gain Adjustment section. (3) Linearity error is specified at any operating frequency from the straight line intersecting 90% of full scale frequency and 0.1% of full scale frequency. See Discussion of Specifications section. Above 200kHz, it is recommended all grades be operated below +85°C. (4) ±0.015% of FSR for negative inputs shown in Figure 5. Positive inputs are shown in Figure 1. (5) FSR = Full Scale Range (corresponds to full scale frequency and full scale input voltage). (6) Exclusive of external components' drift. (7) Positive drift is defined to be increasing frequency with increasing temperature. (8) For operations above 200kHz up to 500kHz, see Discussion of Specifications and Installation and Operation sections. (9) One pulse of new frequency plus 1µs.

ABSOLUTE MAXIMUM RATINGS

Supply Voltage	±22V
Output Sink Current (FOUT)	50mA
Output Current (V _{OUT})	+20mA
Input Voltage, –Input	
Input Voltage, +Input	±Supply
Comparator Input	±Supply
Storage Temperature Range:	
VFC32BM, SM	65°C to +150°C
VFC32KP, KU	25°C to +85°C

PACKAGE/ORDERING INFORMATION

PRODUCT	PACKAGE	PACKAGE DRAWING NUMBER ⁽¹⁾	TEMPERATURE RANGE
VFC32KP	14-Pin Plastic DIP	010	0°C to 70°C
VFC32BM	TO-100 Metal	007	−25°C to +85°C
VFC32SM	TO-100 Metal	007	-55°C to +125°C
VFC32KU	SO-14 SOIC	235	0°C to +70°C

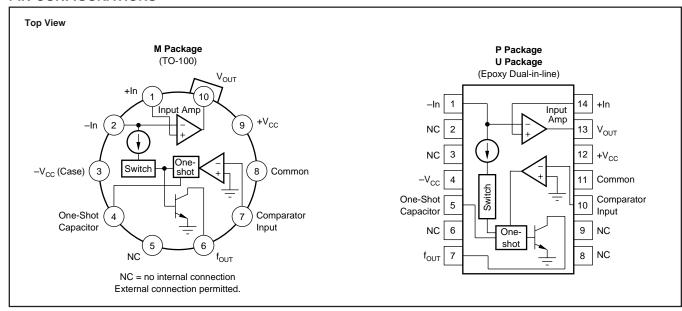
NOTE: (1) For detailed drawing and dimension table, please see end of data sheet, or Appendix C of Burr-Brown IC Data Book.

ELECTROSTATIC DISCHARGE SENSITIVITY

This integrated circuit can be damaged by ESD. Burr-Brown recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

PIN CONFIGURATIONS



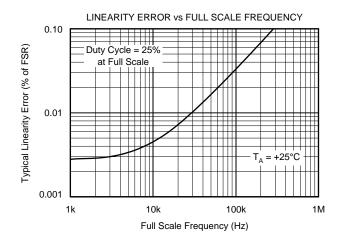
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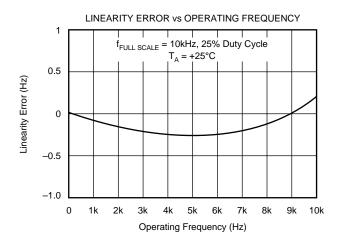
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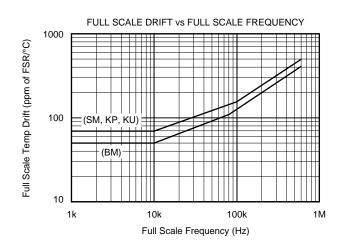
VFC32

TYPICAL PERFORMANCE CURVES

At T_{A} = +25°C and V_{CC} = $\pm 15 \text{V},$ unless otherwise noted.







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APPLICATION INFORMATION

Figure 1 shows the basic connection diagram for frequency-to-voltage conversion. R_1 sets the input voltage range. For a 10V full-scale input, a $40k\Omega$ input resistor is recommended. Other input voltage ranges can be achieved by changing the value of R_1 .

$$R_1 = \frac{V_{FS}}{0.25 \text{mA}} \tag{1}$$

 R_1 should be a metal film type for good stability. Manufacturing tolerances can produce approximately $\pm 10\%$ variation in output frequency. Full-scale output frequency can be trimmed by adjusting the value of R_1 —see Figure 3.

The full-scale output frequency is determined by C₁. Values shown in Figure 1 are for a full-scale output frequency of 10kHz. Values for other full-scale frequencies can be read from Figure 2. Any variation in C₁—tolerance, temperature drift, aging—directly affect the output frequency. Ceramic NPO or silver-mica types are a good choice.

For full-scale frequencies above 200kHz, use larger capacitor values as indicated in Figure 2, with $R_1 = 20k\Omega$.

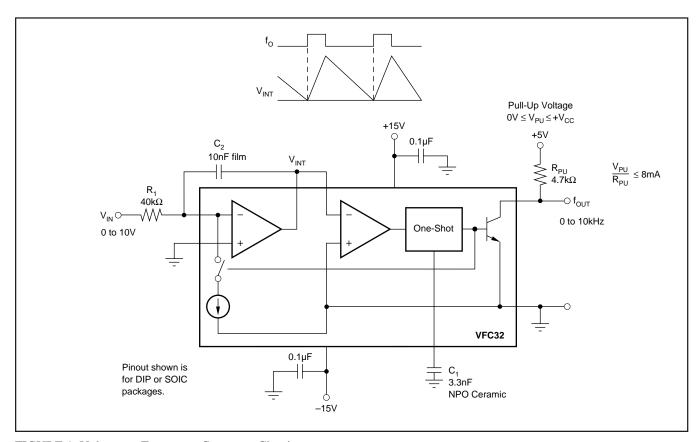
The value of the integrating capacitor, C₂, does not directly influence the output frequency, but its value must be chosen within certain bounds. Values chosen from Figure 2 produce

approximately 2.5Vp-p integrator voltage waveform. If C_2 's value is made too low, the integrator output voltage can exceed its linear output swing, resulting in a nonlinear response. Using C_2 values larger than shown in Figure 2 is acceptable.

Accuracy or temperature stability of C₂ is not critical because its value does not directly affect the output frequency. For best linearity, however, C₂ should have low leakage and low dielectric absorption. Polycarbonate and other film capacitors are generally excellent. Many ceramic types are adequate, but some low-voltage ceramic capacitor types may degrade nonlinearity. Electrolytic types are not recommended.

FREQUENCY OUTPUT PIN

The frequency output terminal is an open-collector logic output. A pull-up resistor is usually connected to a 5V logic supply to create standard logic-level pulses. It can, however, be connected to any power supply up to $+V_{\rm CC}$. Output pulses have a constant duration and positive-going during the one-shot period. Current flowing in the open-collector output transistor returns through the Common terminal. This terminal should be connected to logic ground.



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FIGURE 1. Voltage-to-Frequency Converter Circuit.

VFC32

FREQUENCY-TO-VOLTAGE CONVERSION

Figure 4 shows the VFC32 connected as a frequency-to-voltage converter. The capacitive-coupled input network C_3 , R_6 and R_7 allow standard 5V logic levels to trigger the comparator input. The comparator triggers the one-shot on the falling edge of the frequency input pulses. Threshold voltage of the comparator is approximately -0.7V. For frequency input waveforms less than 5V logic levels, the R_6/R_7 voltage divider can be adjusted to a lower voltage to assure that the comparator is triggered.

The value of C_1 is chosen from Figure 2 according to the full-scale input frequency. C_2 smooths the output voltage waveform. Larger values of C_2 reduce the ripple in the output voltage. Smaller values of C_2 allow the output voltage to settle faster in response to a change in input frequency. Resistor R_1 can be trimmed to achieve the desired output voltage at the full-scale input frequency.

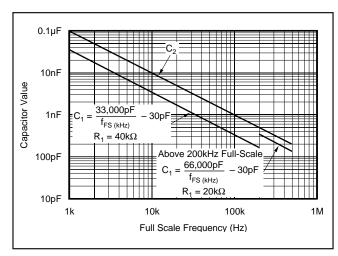


FIGURE 2. Capacitor Value Selection.

PRINCIPLES OF OPERATION

The VFC32 operates on a principle of charge balance. The signal input current is equal to $V_{\rm IN}/R_1$. This current is integrated by input op amp and C_2 , producing a downward ramping integrator output voltage. When the integrator output ramps to the threshold of the comparator, the one-shot is triggered. The 1mA reference current is switched to the integrator input during the one-shot period, causing the integrator output ramp upward. After the one-shot period, the integrator again ramps downward.

The oscillation process forces a long-term balance of charge (or average current) between the input signal current and the reference current. The equation for charge balance is:

$$I_{IN} = I_{R(AVERAGE)}$$
 (2)

$$\frac{V_{IN}}{R_1} = f_O t_{OS} (1mA) \tag{3}$$

Where:

 f_{o} is the output frequency t_{os} is the one-shot period, equal to $t_{os} = 7500 \text{ C}_{1} \text{ (Farads)}$ (4)

The values suggested for R_1 and C_1 are chosen to produce a 25% duty cycle at full-scale frequency output. For full-scale frequencies above 200kHz, the recommended values produce a 50% duty cycle.

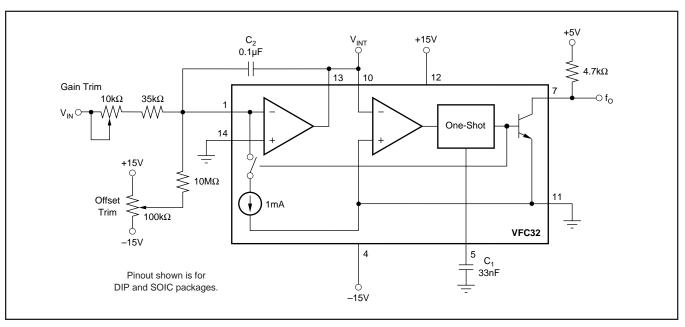


FIGURE 3. Gain and Offset Voltage Trim Circuit.

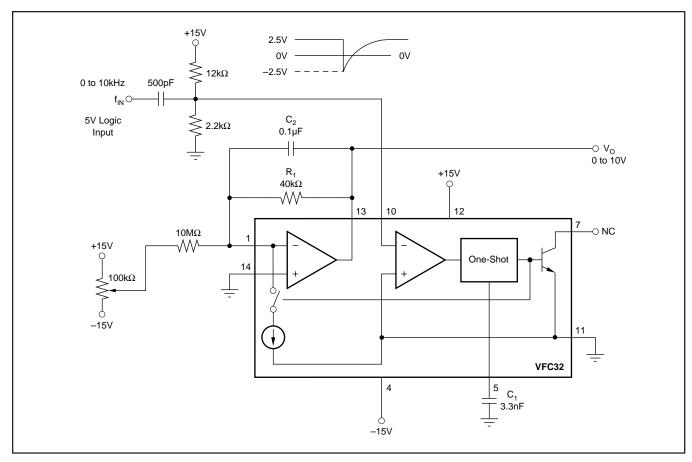
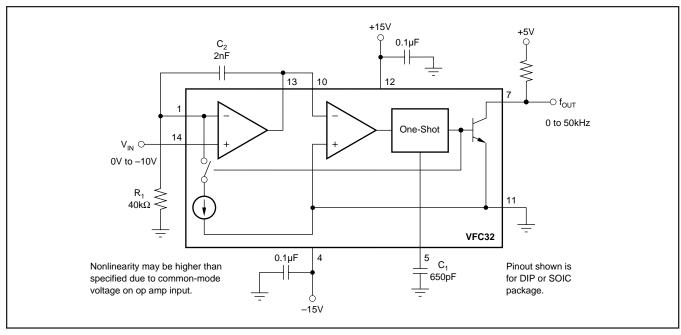


FIGURE 4. Frequency-to-Voltage Converter Circuit.



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FIGURE 5. V/F Converter—Negative Input Voltage.





10-Jun-2014

PACKAGING INFORMATION

Orderable Devic	e Status	Package Type	Package	Pins	Package	Eco Plan	Lead/Ball Finish	MSL Peak Temp	Op Temp (°C)	Device Marking	Samples
	(1)		Drawing		Qty	(2)	(6)	(3)		(4/5)	
VFC32BM	OBSOLET	E TO-100	LME	10		TBD	Call TI	Call TI	-25 to 85		
VFC32KP	ACTIVE	PDIP	N	14	25	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type	0 to 70	VFC32KP	Samples
VFC32KPG4	ACTIVE	PDIP	N	14	25	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type	0 to 70	VFC32KP	Samples
VFC32KU	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	0 to 70	VFC32KU	Samples
VFC32KU/2K5	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	0 to 70	VFC32KU	Samples
VFC32KUE4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	0 to 70	VFC32KU	Samples

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

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Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

- (3) MSL, Peak Temp. The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.
- (4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.
- (5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.



PACKAGE OPTION ADDENDUM

10-Jun-2014

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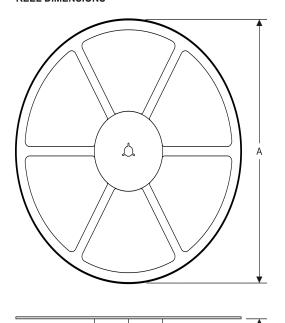
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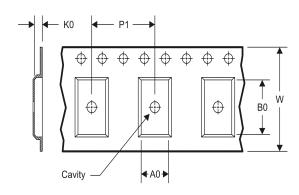
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TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



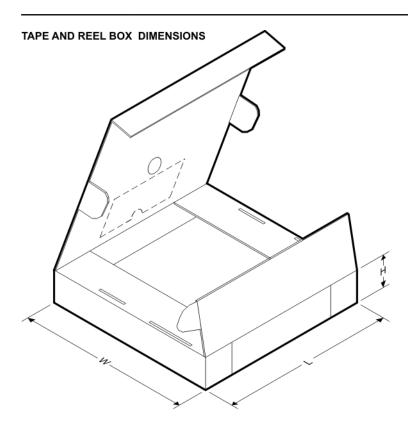
A0	Dimension designed to accommodate the component width
В0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

TAPE AND REEL INFORMATION

*All dimensions are nominal

Device	Package Type	Package Drawing		SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
VFC32KU/2K5	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1

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*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
VFC32KU/2K5	SOIC	D	14	2500	367.0	367.0	38.0

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- 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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