

Fast Charging Physical Layer IC for USB Interfaces

Supports 10 standards: Type-C, QC3.0/QC2.0, FCP, AFC, SFCP, MTK PE+ 2.0/1.1, Apple 2.4A, BC1.2

1. Features

- Support several charging standards including : QC3.0/QC2.0, FCP, AFC, SFCP, MTK PE+ 2.0/1.1 and Apple® 2.4A, Samsung® 2.0A, BC1.2
- Support USB Type-C DFP
 - CC1, CC2 output pull-up automatically
 - Support broadcast 3A maximum current
 - ID1 pin will enable the power rail after negotiate successfully
- Support QC3.0&QC2.0 Class B (Compatible with Class A)
 - QC3.0 Class B: 3.6V~20V (0.2V/step) output voltage
 - QC2.0 Class B: 5 V, 9 V, 12 V or 20V
- Support MTK PE+ 2.0/1.1
 - PE+ 2.0: 5V~20V (0.5V/Step)
 - PE+ 1.1: 3.6V~5V (0.2V/Step), 7V, 9V or 12V
- Support Huawei® FCP of 5V and 9V
- Support Samsung® AFC of 5V and 9V
- Support Spreadtrum® SFCP of 12V, 9V and 5V
- Support Apple® 2.4A: DP=2.7V, DM=2.7V
- Support Samsung® 2.0A: DP=1.2V, DM=1.2V
- Support BC1.2: Automatic shorting D+ to D- line
- SEL configure the maximum voltage, allowed to applied for, as 20V or 12V or 5V
- Default 5 V mode operation
- Support auto-detect and auto-switching fast charging standards
- Support NTC temperature protect function
- Support auto-detect NTC and MTK function
- FB for voltage regulation
- Support NTC temperature protect function
- Support auto-detect NTC and MTK function
- Working voltage: 3V~5.5V
- Very low power consumption $I_Q = 66\mu A(\text{Typ.})$
- Package: DFN12

2. Typical Applications

- USB power output ports for AC adapters, Power Bank, Car chargers
- Battery chargers for smart phones, tablets, netbooks, digital cameras, and Bluetooth accessories

3. Description

IP2705 is a low-cost fast charging Physical Layer IC dedicated for USB ports, which supports 10 kinds of fast charging standards, including Type-C DFP, HVDCP QC3.0/QC2.0 (Quick Charge) Class A&B, FCP (Hisilicon® Fast Charge Protocol), AFC (Samsung® Adaptive Fast Charge), SFCP (Spreadtrum® Fast Charge Protocol), MTK PE+ 2.0/1.1 (MediaTek Pump Express Plus 2.0/1.1), Apple® 2.4A, BC1.2 and Samsung® 2.0A.

IP2705 integrated USB Type-C DFP port controller, which can co-work with Type-C UFP/DRP devices.

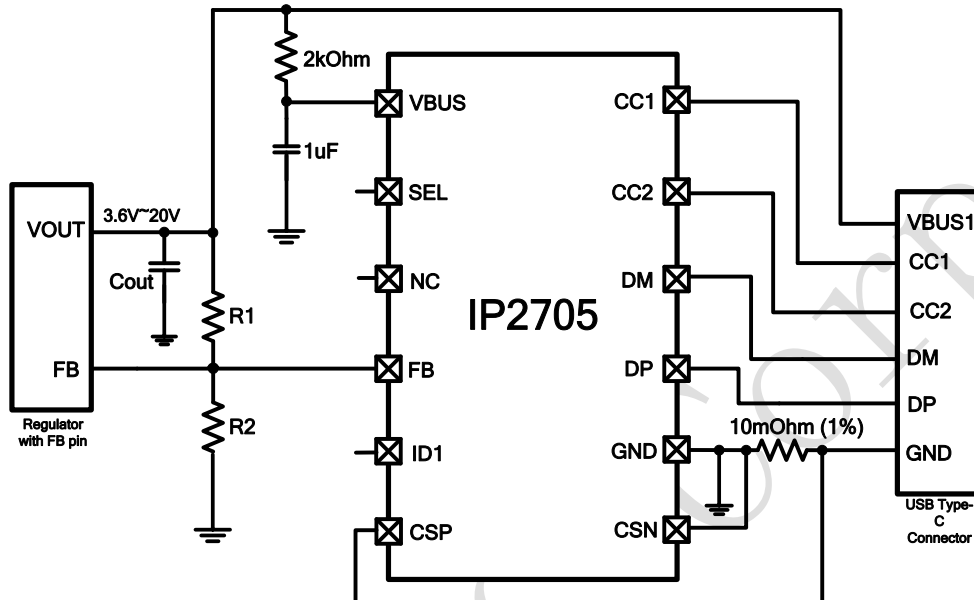
IP2705 support automatically detecting the connected device's type and switching standards type to responding for fast charging requirements.

FB control line is integrated to source/sink current with precise 2uA/step in minimum, for accurate voltage regulation.

Support NTC over temperature protect function

4. Typical Application Schematic

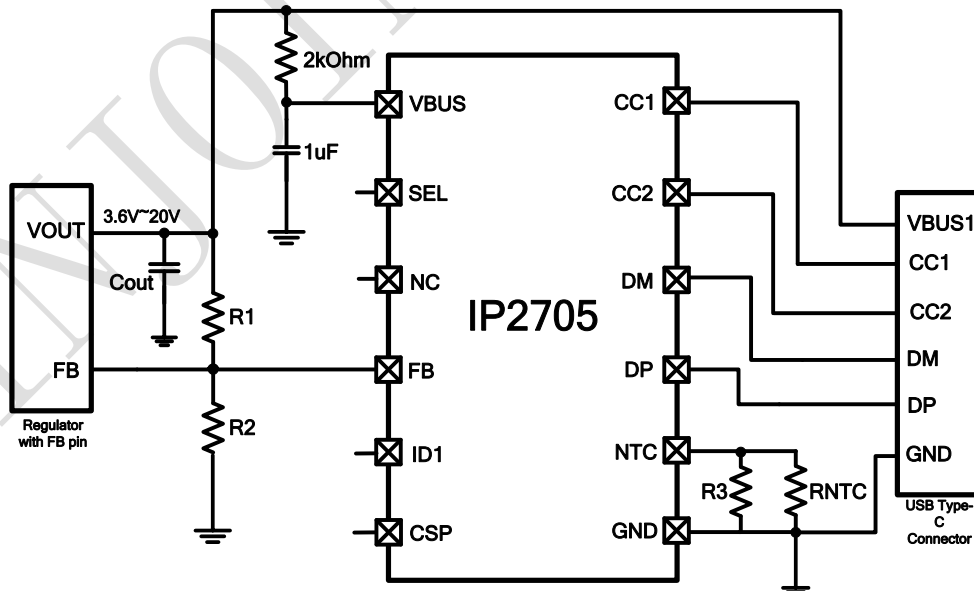
Pin 3, Pin 12 used as CSN and CSP:



R1 Recommend: 100kOhm (1% accuracy)
 R2 refer to the regulator adopted

SEL	Voltage
High	5V
Float	12V
GND	20V

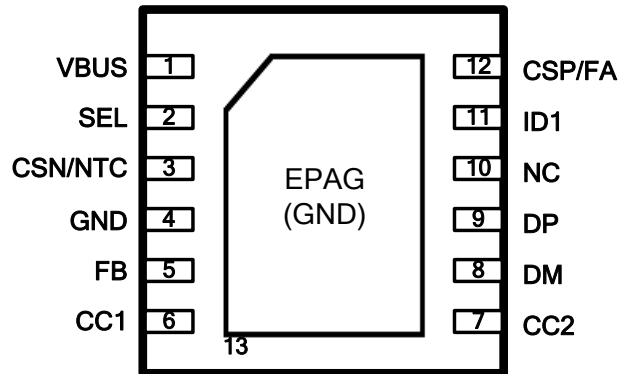
Pin 3, Pin 12 used as NTC and FA:



R1 Recommend: 100kOhm (1% accuracy)
 R2 refer to the regulator adopted

SEL	Voltage
High	5V
Float	12V
GND	20V

5. PIN Description



Pin Name	Pin No.	Pin Description
VBUS	1	Power supply input, connect with 1uF capacitor to GND, a resistor of 2kOhm should be applied between VOUT and VBUS
SEL	2	Configure the maximum voltage allowed to apply for: <ul style="list-style-type: none"> • V_{SELH} for 5V output • Floating for 12V output • GND for 20V output
CSN/NTC	3	This pin is multiplexed as CSN and NTC two functions: <ol style="list-style-type: none"> 1) CSN: current detect negative pin. In MTK PE+ 2.0/1.1 mode, this pin is connected to the IC's GND pin. A resistor of 10mOhm (1%) should be applied between IC's GND pin and USB port's GND. In this condition, NTC function is disabled automatically 2) NTC: temperature sensitive resistor detect pin. In NTC mode, this pin connect to paralleled RNTC and R3 resistors to GND, MTK PE+ 2.0/1.1 function is disabled automatically. The resistor of 10mOhm (1%) between IC's GND and USB port's GND can be eliminated When neither of these two functions are needed, CSN,CSP pins left floating, IC's GND and USB port's GND are connected together
GND	4	Ground
FB	5	Connect to the Regulator's FB line, current source/sink for voltage regulation
CC1	6	Connect to USB Type-C CC1 pin
CC2	7	Connect to USB Type-C CC2 pin
DM	8	Connect to USB DM data line
DP	9	Connect to USB DP data line
NC	10	NC
ID1	11	Type-C power rail control pin
CSP/FA	12	This pin is multiplexed as CSP and FA two functions: when pin 3 is CSN function, this pin is CSP; when pin 3 is NTC, this pin is FA. <ol style="list-style-type: none"> 1) CSP: current detect positive pin. In MTK PE+ 2.0/1.1 mode, this pin is connected to

		<p>USB port's GND. A resistor of 10mOhm (1%) should be applied between IC's GND pin and USB port's GND. In this condition, NTC function is disabled automatically</p> <p>2) FA: abnormal temperature flag. In NTC mode, the resistor of 10mOhm (1%) between IC's GND and USB port's GND can be eliminated.</p> <p>When neither of these two functions are needed, CSN,CSP pins left floating, IC's GND and USB port's GND are connected together</p>
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6. IP Series Products List

Power Bank IC

IC Part No.	Charge /Discharge		Features							Package	
	Charge	Dis-charge	LED Num	Lighting	Keys	I2C	DCP	Type-C	QC Certificate	Package	Compa tibility
IP5303	1.0A	1.2A	1,2	√	√	-	-	-	-	eSOP8	PIN2PIN
IP5305	1.0A	1.2A	1,2,3,4	√	√	-	-	-	-	eSOP8	
IP5306	2.4A	2.1A	1,2,3,4	√	√	-	-	-	-	eSOP8	
IP5206	2A (Max)	1.5A	3,4,5	√	√	-	-	-	-	eSOP16	PIN2PIN
IP5108E	2.0A	1.0A	3,4,5	√	√	-	-	-	-	eSOP16	
IP5108	2.0A	2.0A	3,4,5	√	√	√	-	-	-	eSOP16	
IP5207	1.2A	1.2A	3,4,5	√	√	-	-	-	-	QFN24	PIN2PIN
IP5207T	1.2A	1.2A	1,2,3,4	√	√	√	√	-	-	QFN24	
IP5109	2.1A	2.1A	3,4,5	√	√	√	-	-	-	QFN24	
IP5209	2.4A	2.1A	3,4,5	√	√	√	√	-	-	QFN24	
IP5219	2.4A	2.1A	1,2,3,4	√	√	√	√	√	-	QFN24	
IP5310	3.1A	3.0A	1,2,3,4	√	√	√	√	√	-	QFN32	
IP5312	15W	3.6A	2,3,4,5	√	√	√	√	-	-	QFN32	
IP5318Q	18W	4.0A	2,3,4,5	√	√	√	√	-	√	QFN40	PIN2 PIN
IP5318	18W	4.0A	2,3,4,5	√	√	√	√	√	√	QFN40	
IP5322	18W	4.0A	1,2,3,4	√	√	√	√	-	√	QFN32	
IP5328	18W	4.0A	1,2,3,4	√	√	√	√	√	√	QFN40	

USB Charging Port Control IC

IC Part No.	Channel Num	Standards Supported											Package
		BC1.2 & APPLE	QC3.0 & QC2.0	FCP	SCP	AFC	SFCP	MTK PE+ 2.0&1.1	Type-C	NTC	QC Certificate	PD3.0	
IP2110	1	√	-	-	-	-	-	-	-	-	-	-	SOT23-5
IP2111	1	√	-	-	-	-	-	-	-	-	-	-	SOT23-6
IP2112	2	√	-	-	-	-	-	-	-	-	-	-	SOT23-6

IP2161	1	√	√	-	-	-	√	-	-	-	√	-	SOT23-6
IP2163	1	√	√	√	-	√	√	√	-	√	√	-	SOP8
IP2701	1	√	√	√	-	√	√	-	√	-	-	-	SOP8
IP2703	1	√	√	√	-	√	√	√	√	√	-	-	DFN10
IP2705	1	√	√	√	-	√	√	√	√	√	-	-	DFN12
IP2707	2	√	√	√	-	√	√	√	√	√	-	-	QFN16
IP2716	1	√	√	√	√	√	-	1.1	√	-	√	√	QFN32

7. Absolute Maximum Ratings

Parameters	Symbol	Value	Unit
VBUS Input Voltage Range	VBUS	-0.3 ~ 7	V
DP, DM Input Voltage Range	V _{DP} , V _{DM}	-0.3~11	V
CC1,CC2 input Voltage Range	V _{CC1} , V _{CC2}	-0.3~12	V
Junction Temperature Range	T _J	-40 ~ 150	°C
Storage Temperature Range	T _{stg}	-60 ~ 150	°C
Ambient Temperature Range	T _A	-40~150	°C
Human Body Model (HBM)	ESD	4	KV

*Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to Absolute Maximum Rated conditions for extended periods may affect device reliability.

*Voltages are referenced to GND unless otherwise noted.

8. Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input Voltage	VBUS	3		5.5	V
Ambient Temperature	T _A	-40		85	°C

*Devices' performance cannot be guaranteed when working beyond those Recommended Operating Conditions.

9. Electrical Characteristics

Unless otherwise specified, T_A=25°C, 4.5V ≤ VBUS ≤ 5.5V

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Quiescent Current	I _Q	No load, VBUS=5V	50	66	100	uA
Startup Time	T _S		8	10	12	ms
SEL Input High Voltage Range	V _{SELH}		3	5	5.5	V
SEL Default Output Voltage	V _{SELO}		1.35	1.5	1.65	V

10. Function Description

Charging Standards

IP2705 is a high-voltage, fast charging Physical Layer IC dedicated for charging applications where charging standards required to be negotiated between USB ports. IP2705 is needed at the host-side, when the attached portable client-side device negotiate the power allotment from the power source host-side, IP2705 can auto-detect and respond to the those charging standards and may grant or deny the request based on the available voltage/current. IP2705 will inform the power source host-side to adjust the output voltage by FB line once charging request granted.

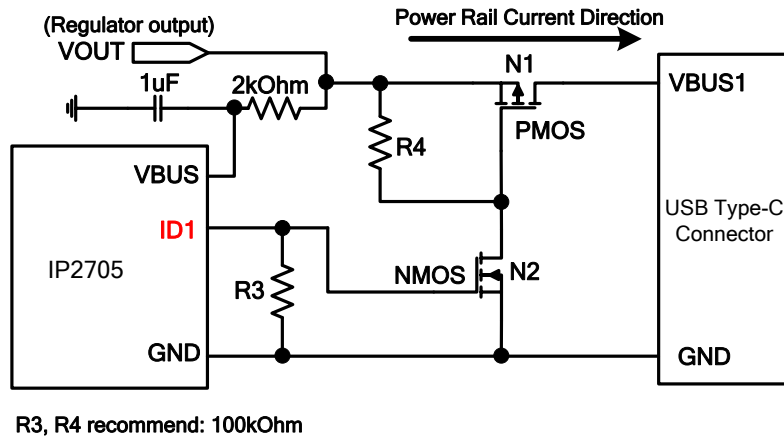
IP2705 support analysis several charging standards, including HVDCP QC3.0/QC2.0 (Quick Charge) Class A, FCP (Hisilicon® Fast Charge Protocol), AFC (Samsung® Adaptive Fast Charge), SFCP (Spreadtrum® Fast Charge Protocol), MTK PE+ 2.0/1.1 (MediaTek Pump Express Plus 2.0/1.1), Apple® 2.4A, BC1.2 and Samsung® 2.0A.

IP2705 monitors the real-time voltage on DP line and DM line, when the attached device is not the fast charging type, IP2705 will change the voltage on the DP, DM line to fulfill the negotiation process. When fast charging client-side device connected, IP2705 auto-detect the type of charging standard and analysis the power requirements, source/sink current on FB line to grant the request voltage. When the output voltage is default 5V, FB line neither source nor sink current. IP2705 is not in control of the charging power loop, the actual charging loop and charging current is determined by the host-side power source and the client-side USB port device.

IP2705 integrated USB Type-C DFP port controller, support discharge to devices, at which moment CC1, CC2 will output 330uA current, for 3A maximum current capability broadcasting, IP2705 can work with Type-C UFP and DRP devices.

ID1

ID1 pin is used to control open or close the Type-C power rail, when Type-C made successful handshake as DFP, ID1 will output high level voltage to open the PMOS and NMOS on the Type-C power rail, then the regulator VOUT will output to the Type-C device's VBUS1 through PMOS (N1). The ID1 pin and MOSFET configuration refer to the figure below.



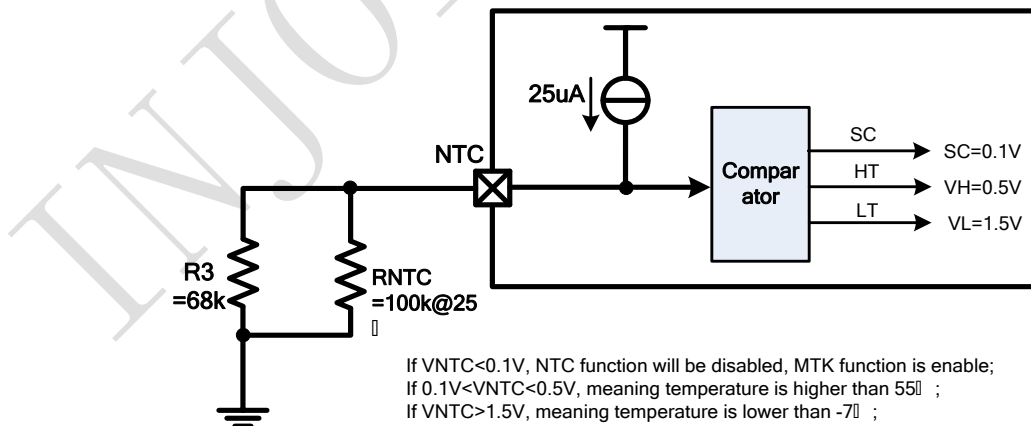
Type-C DFP application ID1 circuit

SEL

SEL line is used to configure the maximum voltage allotment that can be request, when SEL line is pull up to high-voltage of V_{SELH} , the IP2705 will not respond to any fast charging requirements and output default 5V; When SEL line is floating, the maximum voltage allotment is 12V; When SEL line is pull down to GND, the maximum voltage allotment is 20V.

SEL	Voltage
High (V_{SELH})	5V
Float	12V
GND	20V

NTC and FA



IP2705 integrated NTC temperature sensitive resistor detect function, and support abnormal temperature indication on FA pin. NTC and FA are multiplexed with CSN and CSP function on pin 3 and pin 12, only one function is enabled at the same time.

When pin 3 is connected to ground, internal comparator will detect that $V_{NTC} < 0.1V$, in this condition, pin 3 and pin 12 are CSN and CSP (MTK PE+ 2.0/1.1) function, a resistor of 10mOhm (1% accuracy) should be applied

between the IC's GND and USB port's GND. Herein the NTC and FA function are disabled automatically.

When pin 3 is connected to the paralleled R3 and RNTC resistors to ground, in this condition, pin 3 and pin 12 are NTC and FA function, MTK PE+ 2.0/1.1 is disabled automatically. NTC pin will detect the temperature, when the temperature is abnormal, FA will output high level (equals VBUS), otherwise the FA output low level (GND).

When detected $V_{NTC} > V_L$ (1.5V), meaning that the temperature is lower than -7°C , FA will output high level; when detected SC (0.1V) $< V_{NTC} < V_H$ (0.5V), meaning that the temperature is higher than 55°C , FA will output high level; when detected V_H (0.5V) $< V_{NTC} < V_L$ (1.5V), meaning that the temperature is in normal range of $-7^{\circ}\text{C} \sim 55^{\circ}\text{C}$, FA will output low level.

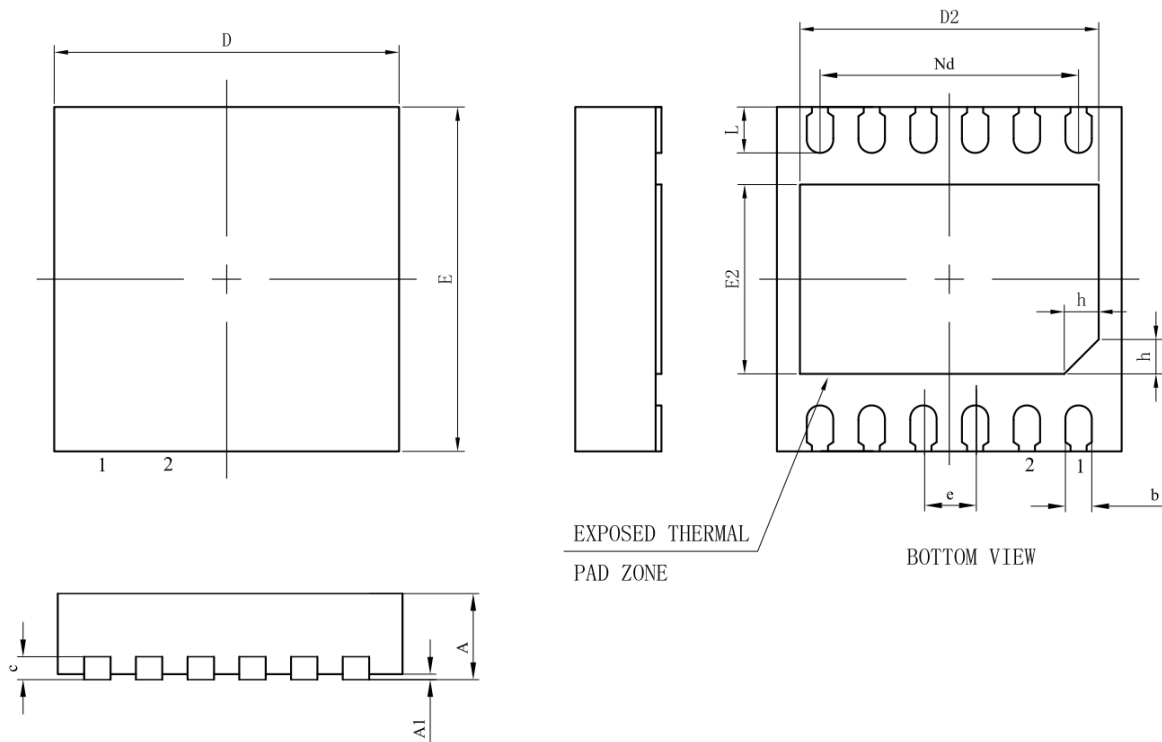
FB

IP2705 integrated FB control line used for accurate voltage regulation by source/sink current with precise 2uA/step in minimum. FB source 40uA current for 9V output voltage; FB source 70uA current for 12V output voltage; FB source 150uA current for 20V output voltage; when the output voltage is default 5V, FB neither source nor sink current.

In typical applications, IP2705 FB connects to the regulator's FB line, resistor (R1) between VOUT and FB should apply 100kOhm with high precision (1%), resistor (R2) value between FB and GND should refer to the regulator adopted, resistance of R2 can be calculated by equation:

$$V_{FB} = \frac{V_{OUT}}{R1 + R2} * R2$$

11. Package



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	—	0.02	0.05
b	0.16	0.23	0.28
c	0.18	0.20	0.25
D	2.90	3.00	3.10
D2	2.40	2.50	2.60
e	0.45BSC		
Nd	2.25BSC		
E	2.90	3.00	3.10
E2	1.45	1.55	1.65
L	0.30	0.40	0.50
h	0.20	0.25	0.30
L/F载体尺寸 (Mil)	106*75		

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