

# Optionals

## Measurement/Analysis Software TC-7100 for Small FWD System®

### OUTLINE

This is a software for controlling Small FWD and analyzing measured data using personal computer which runs on Windows-PC. Computer is connected to exclusive indicator with RS-232C and controls Small FWD System. Measured and stored data by the exclusive indicator can be indicated on the computer display or printed by external printer.

### FEATURE

- Load and displacement measurements of four channels at maximum are possible
- Analysis result is indicated immediately after measurement
- Indication and printing of measured data are possible

### Operation environment

Computer	
OS	Windows-PC
CPU	Pentium(150MHz) or higher is recommended
HDD	2G-byte or more
Main memory	128M-byte or more
Display	Resolution 800×600 pixels or more
Interface	RS-232C D-sub 9 pins
PC card	Conforms to PCMCIA2.1 standard TYPE II
Printer	Applicable to installed OS
Mouse	Applicable to installed OS
Instruments	
Small FWD exclusive indicator	TC-351F 1 unit
Small FWD main body	KFD-100A 1 unit
External displacement sensor	KFDS-1A (option) 2 units at maximum

FWD-Light Measurement/Analysis Software (History)

No	Date Time	Load P0	Disp. D0	K-TML	E-TML	Disp. D1	Disp. D2
		N	mm	MN/m <sup>3</sup>	MN/m <sup>2</sup>	mm	mm
00171	2002/04/04 19:13:52	1037	0.379	58	16	0.106	0.099
00170	2002/04/04 19:12:28	953	0.363	56	15	0.104	0.097
00140	2002/04/04 17:28:41	2715	0.149	388	106	0.041	0.038
00139	2002/04/04 17:27:30	2697	0.150	382	104	0.041	0.037
00138	2002/04/04 17:22:51	2709	0.148	390	106	0.041	0.038
00116	2002/04/04 16:36:09	2773	0.098	598	163	0.030	0.023
00115	2002/04/04 16:33:49	2735	0.091	635	173	0.028	0.020

Example of data analysis display

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 Microsoft-Windows, Windows of Microsoft, Inc.  
 Compact flash of San Disk Corporation  
 FWD-Light of Tokyo Sokki Kenkyujo Co., Ltd.

### PRODUCT CONFIGURATION

Product	Compact set	Standard set	Standard accessory Remarks
Main body: KFD-100A with built-in • Load cell • Acceleration transducer	●	●	Weight (5kg): KDFD-11-05 Loading plate(φ100×t15mm): KDFD-31-100 5m cable
Indicator: TC-351F • Display • RS-232C interface • Memory card slot	●	●	AC power pack: CR-1870 Battery
Aluminium case for carrying and storing: KFDF-21-1	—	●	Stores main body, exclusive indicator and options (external displacement sensor and exclusive printer)
32M-byte compact flash memory card	—	●	
Memory card adaptor	—	●	
Data acquisition software for TC-351F: TC-7351	●	●	Requires optional RS-232C cable of CR-5360

### OPTIONS

Product	Type	Remarks
External displacement sensor	KFDS-1A	5m cable supplied
Additional weight 10kg	KDFD-11-10	
Additional weight 15kg	KDFD-11-15	
Loading plate (φ200mm)	KDFD-31-200	φ200×t15mm
Loading plate (φ300mm)	KDFD-31-300	φ300×t22mm
Aluminium case for carrying and storing	KDFD-21-2	
Measurement/Analysis software	TC-7100	for Microsoft Windows 98/Me/NT4.0/2000
RS-232C connection cable	CR-5360	
32M-byte flash memory card		
Exclusive printer	DPU-H245AS	
Printer connection cable	CR-5610	
Printing paper	TP-202L	

Specifications subject to change without prior notice.

ISO9001



Approval Certificate No.: 957261  
 Design and manufacture of strain measuring equipment  
 Manufacture of transducers  
 No.2 and No.3 Production Divisions  
 (Tokyo Head Office and Kiryu Factory)



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# TML

TML Small FWD System

# FWD-Light

## MEASURES RIGIDITY OF SUBGRADE

- Indicates and stores load, displacement coefficient of subgrade reaction and modulus of subgrade elasticity
- Small, Light and Easy operation
- Acquires a lot of data in a short period of time
- 2-wire digital network lines
- Battery operation
- Flash memory card

Exclusive Indicator  
**TC-351F**



Small FWD main body  
**KFD-100A**



Measurement/Analysis Software  
**TC-7100 (option)**

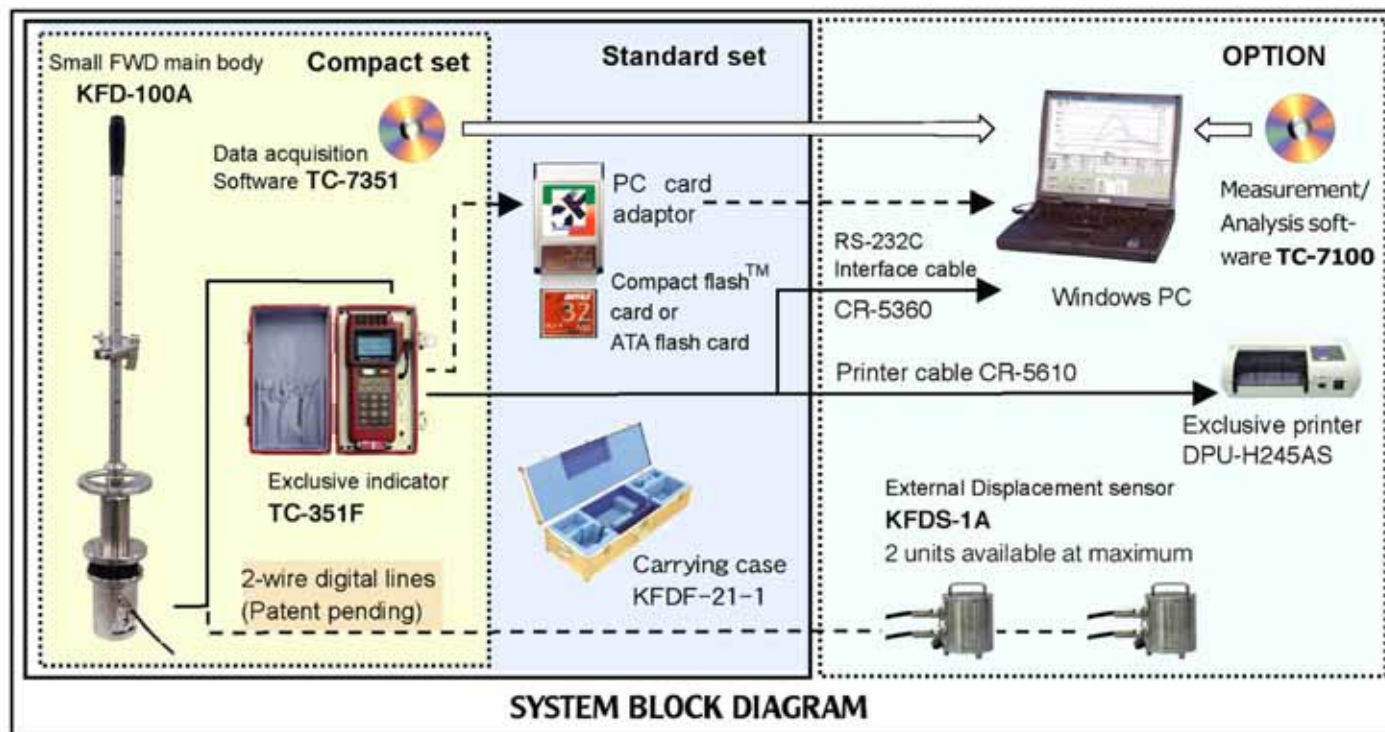


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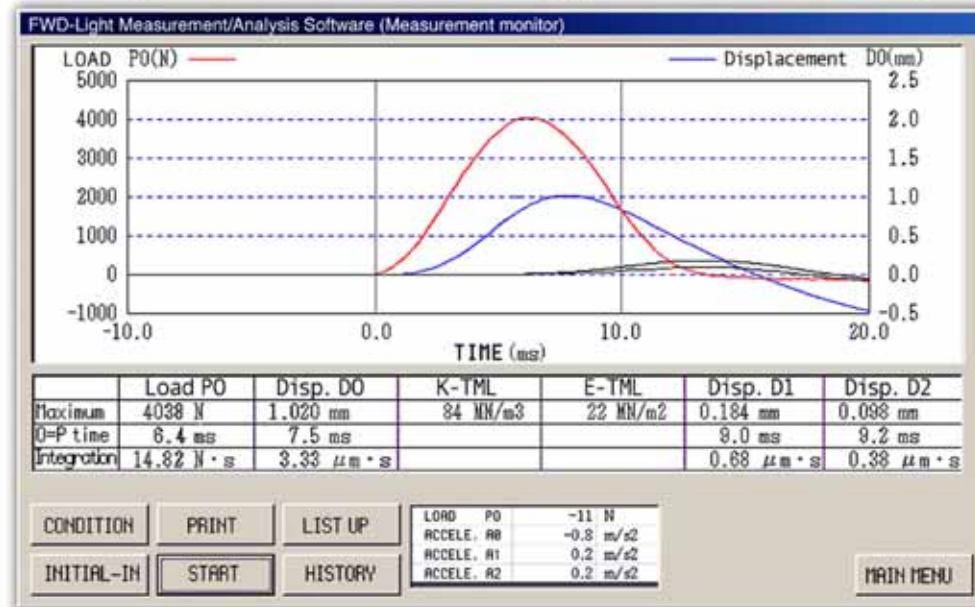
# TML Small FWD System *FWD-Light*®

## ■ OUTLINE OF SYSTEM

FWD (Falling Weight Deflectometer) is used for estimating construction of pavement or rigidity of subgrade. Also, plate loading test is used for estimating characteristics of subgrade. However, these methods require much time and works for their preparation, data acquisition and analysis. TML small FWD System "*FWD-Light*®" features excellent portability and enables simple and quick measurement of coefficient of subgrade reaction which is called **K** value and modulus of subgrade elasticity which is called **E** value. *FWD-Light* consists of main body KFD-100A and indicator TC-351F. The main body includes load cell and acceleration transducer whose measuring ranges are 20kN of load and 2.5mm of displacement at maximum. Values of maximum load and displacement, and analysis results of K value and E value are indicated on the indicator. Each analysis result can be stored in memory card and printed by exclusive printer. Data stored in memory card can be transferred to a personal computer by directly connecting the card or via the indicator. Measurement and processing software **TC-7100** is available as an optional item for indicating waveforms of load acceleration, velocity and displacement, O-P time and time product using personal computer.



## ■ Example of waveform indication using optional Measurement/Analysis Software TC-7100



— : Load P0  
 — : Displacement D0  
 — : External displacement D1  
 — : External displacement D2

**K-TML** : Coefficient of subgrade reaction  
**E-TML** : Modulus of subgrade elasticity

**O-P time**: Time between rising and peak of waveform  
**Integration**: Areal dimensions of O-P time

## ■ OUTLINE OF OPERATION

In this system, weight of main body of Small FWD is made to fall freely, and shock load and displacement by the falling are measured by load cell and acceleration transducer. Displacement is obtained by integrating the acceleration twice. Measurement of external displacement of two points at maximum is available by combining external displacement sensor KFDS-1A. TML's original process (patent pending) is employed for integrating acceleration data to obtain displacement with high accuracy and good stability. Outputs of load cell and acceleration transducer are digitized by internal A/D converter of Small FWD main body and transmitted to indicator utilizing TML's original 2-wire network technique (patent pending). The indicator indicates results of analyses and also saves them into memory card. Measurement/Analysis software (TC-7100) is required for measurement system with personal computer. In this system, data indicated on the indicator are transferred to the computer through the indicator without modification. Personal computer displays waveforms of load and displacement and also processes each analysis.

## ■ Small FWD main body KFD-100A

<b>Dimensions of loading plate</b>	φ100×15(thick) mm
<b>Mass of weight</b>	5 kg
<b>Falling height</b>	50~550 mm
<b>Falling method of weight</b>	Lever (with stopper)
<b>Maximum load</b>	20000N
<b>Maximum displacement</b>	2.500 mm
<b>Strain gauge based sensor</b>	
Load cell	1 point, 20000N
Acceleration transducer	1 point, 500m/s <sup>2</sup>
<b>Data acquisition</b>	
No. of measuring points	2 points (load and acceleration)
Measuring accuracy	±(0.1% rdg+2 digit) (at 23±5°C)
Data memory	800 data/point
Sampling speed	50 μ sec
Trigger function	By data (load value)
<b>Interface</b>	Exclusive 2-wire serial transfer
<b>No. of external displacement sensor</b>	2 points at maximum
<b>Power source</b>	Supplied by TC-351F
<b>Environment</b>	-20~+60°C, less than 85%RH (no condensation)
<b>Height</b>	Approx. 1100 mm
<b>Weight</b>	Approx. 15 kg (including 5kg weight)

## ■ Exclusive Indicator TC-351F

<b>Display</b>	Liquid crystal display 128×64 dots
Monitor	Load, Acceleration, Acceleration of external sensor, Time
Analysis result	Maximum load, Maximum displacement, Maximum displacement of external sensor, Coefficient of subgrade reaction (K <sub>TML</sub> ), Modulus of subgrade elasticity (E <sub>TML</sub> ), Indicates results of last four measurements
<b>Example of indication</b>	
A000 12:00:00	A000 12:00:00
P0 D0 K-TML	E-TML D1 D2
No. [N] [mm] [MN/m <sup>3</sup> ]	No. [MN/m <sup>2</sup> ] [mm] [mm]
04 3290 C. 501 279	04 49 0.022 0.013
08 3122 C. 457 290	05 51 0.021 0.012
02 2751 C. 402 290	02 51 0.018 0.012
01 2046 C. 386 258	01 46 0.012 0.011
Moni. Set Next	Moni. Set Back
<b>Stored data indication</b>	Monitor of external displacement sensor
Stored data indication	Stored data in specified file number in memory card
Stored data in three continual measurements included	
<b>File management</b>	Deletion of stored data in specified file number formatting of memory card
<b>Real time clock</b>	
Setting	Year, Month, Day, Hour, Minute, Second
Accuracy	±2 sec./day (at 23±5°C)
<b>Memory card</b>	Storing result of analysis
Card standard	Conforms to PC card standard (Type II)
Card type	Compact flash memory card (with card adaptor) or ATA flash memory card
Card capacity	8~128MByte
Data format	CSV
<b>Interface</b>	For using optional Measurement/Analysis software TC-7100
Standard Function	RS-232C
Function	Receiving control command, Sending measured data, Output to exclusive printer
<b>Power source</b>	
Battery	Nickel-Hydride (Ni-MH) battery pack
Continual operation	Approx. 32 hours of 1000 times measurements (at 23±5°C). In case of measuring 30 times/1 hour by standard configuration without options with fully charged battery
<b>Vibration tolerance</b>	30m/s <sup>2</sup> (at 50Hz 0.6mm <sub>rms</sub> )
<b>Drip-proof</b>	IP-54 (with cover installed)
<b>Environment</b>	-10~+50°C, less than 85%RH (no condensation)
<b>Dimensions</b>	Approx. 150(W)×120(H)×265(D) mm
<b>Weight</b>	Approx. 3kg

## ■ Calculation of Coefficient of subgrade reaction

$$K_{TML} = \frac{P}{\pi r^2 D} \times \frac{R}{R_{300}} \times 10^3$$

**K<sub>TML</sub>** : Coefficient of subgrade reaction obtained by TML  
**K<sub>TML</sub>** : Small FWD System (MN/m<sup>3</sup>)  
**P** : Load (N)  
**D** : Displacement (mm)  
**r** : Radius of loading plate (mm)  
**R** : Diameter of loading plate R=2r (mm)  
**R<sub>300</sub>** : Diameter of standard loading plate (φ300mm)

## ■ Calculation of Modulus of subgrade elasticity

$$E_{TML} = \frac{2(1-\nu^2)P}{\pi r D}$$

**E<sub>TML</sub>** : Modulus of subgrade elasticity obtained by TML  
**E<sub>TML</sub>** : Small FWD System (MN/m<sup>2</sup>)  
**P** : Load (N)  
**D** : Displacement (mm)  
**r** : Radius of loading plate (mm)  
**ν** : Poisson's ratio (0.30, available to change)

## ■ Optional External Displacement Sensor KFDS-1A

<b>Maximum displacement</b>	1.000mm(sensor is an acceleration transducer)
<b>Dimensions</b>	φ90×129(H)mm
<b>Weight</b>	Approx. 2.5 kg